The Electrical Review

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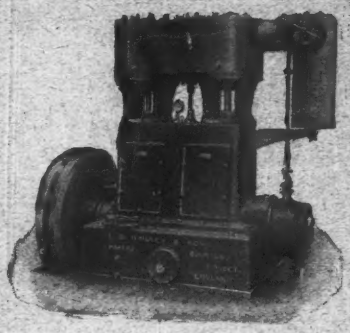

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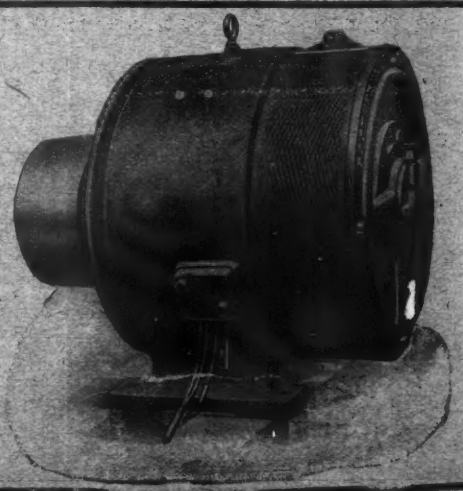

THE

ELECTRICAL REVIEW.

VOL. LXXX. APRIL 6, 1917. No. 2,054.

ELECTRICAL REVIEW.

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THE METRIC SYSTEM.

THE arguments in favour of the adoption of decimal coinage and metric weights and measures were admirably stated by Mr. Harry Allcock in his lecture before the Institution of Civil Engineers last week. In passing, we may be allowed to congratulate the Institution on the progressive spirit which it has displayed in organising these series of lectures on commercial and financial aspects of the engineering industry; however laudable may be the desire to maintain the proceedings of our great engineering societies on a high plane of technical propriety, it cannot be denied, even though it has been ignored in the past, that the engineer is everywhere confronted in his work by the all-important question of costs and balance-sheets, and himself is usually under the necessity of earning a livelihood by his profession. Hence, an ostrich-like pretence that trade and finance have no concern for him is mere affectation, and we are glad to see that both the civil and electrical engineers have begun, somewhat shyly it may be, but effectively, to recognise their responsibilities in this connection.

While we do not profess to have covered all the ground that was so ably traversed by Mr. Allcock—though he did us the honour to quote freely from our pages, with frank acknowledgment—we may at least claim that in the main our efforts and his to bring this matter to a head have proceeded upon parallel lines, and we are so fully in agreement with his contentions that we need not discuss them at length—our views are well known to our readers. The conversion of our coinage to a decimal system is so simple a matter that it hardly calls for comment; the tide seems to be flowing strongly in the direction which, we have contended, involves the least disturbance to accustomed values—namely, the retention of the sovereign as the fundamental unit, decimally sub-divided. The value of the British sovereign is familiar to all nations, but if any system based upon the penny were adopted, not only would the whole of our gold and silver coinage have to be scrapped, but also we should throw away that useful, though not indispensable, world-wide acquaintanceship, and the difficulties to be overcome at home in effecting the change would be magnified a hundredfold.

With regard to metric weights and measures, it is interesting to note that while our canvass of 1915 showed a result of 80 per cent. in favour of the change, that of the British Engineers' Association in January last showed from 83 to 87 per cent. in favour—a decided advance upon our figures.

In the discussion which followed the lecture, the weight of opinion and the sentiment of the audience appeared to be distinctly favourable to the author's contentions. Sir Guilford Molesworth, Mr. Oliver Bury, Mr. C. P. Sparks—speaking for the Council of the sister Institution—Mr. E. C. Barton, and Dr. G. B. Hunter all spoke with deep conviction as to the necessity, not merely the desirability, of making the change, especially in view of the imperative requirements of our foreign trade. Sir Archibald Denny, while opposed to the movement, apparently on the ground that it might lead to such extravagances as the adoption of 10 hours in lieu of 24, and the division of the year into 10 months, &c., admitted that he was advocating an unpopular cause. May we point out that the very essence of

the movement is to promote international uniformity, and that this purpose could not be served by such proposals as those to which he objected? Prof. Unwin remarked that five-eighths of the trade of the world was carried on by the United States and the British Empire, on the basis of English units of length (he had no objection to the adoption of the kilogram); has it not occurred to him that of that trade the vast bulk consists in the import or export of unwrought materials, such as coal, cotton, wool, grain, other foodstuffs, oil, metals, &c., the whole of which are measured in terms of weight or volume? Not only does Prof. Unwin's argument afford no support to the inch unit of length—it does not appear to be based upon correct premises, for according to *Whitaker's Almanack*, the value of the world's trade amounted to about 6,000 millions sterling in 1911, of which the British Empire and the United States together were responsible for some 2,500 millions—less than half; allowing for the countries not committed wholly to metric units, we find that roughly one-half of the world's trade in 1911 was conducted on the metric system. The fact, mentioned by Prof. Unwin, that on the issue of the standard sections of the British Engineering Standards Committee, the Germans at once began to make those sections, merely proves their eagerness to export iron and steel to us—not that there was any special virtue in inch measurements.

Mr. Aspinall cited the opinion of Mr. Coleman Sellers in opposition to the use of the metric system in the workshop. Be it noted that Mr. Sellers is stated to have used the metric system in his shops for *twenty years*! before he arrived at that decision; either, therefore, he was exceedingly slow in making up his mind, or the disadvantages were of so little moment that they did not become apparent to Mr. Sellers until after an extraordinarily long period of probation. On the other hand, we think Mr. Sellers may have been influenced by the consideration that his customers, mainly American and British, used the English system, and therefore he had to do the same: now, *our* customers use the metric system very largely, and soon almost all our foreign markets will be wholly metric. As for the argument put forward by Mr. Aspinall, that every one of one and a half million wagons would have to be reweighed and retared at a cost of no less than 5s. each—a total of about £400,000—surely he does not expect us to take him seriously. Are the present tares correct? If so, a reference to a table of equivalents, and a few minutes' work with a pot of paint and a set of stencils will effect the change at a cost more fairly stated at 5d. each. On the other hand, is it not the case that every railway wagon has to be retared in English units at frequent intervals? Mr. Aspinall further asked whether our internal trade within the Empire or our foreign trade was the most important to us. Possibly he is not aware that Australasia, as Mr. Barton pointed out, will not wait; the legislatures of both Australia and New Zealand have placed the metric system on their statute books, with only one clause preventing its immediate enforcement—a clause providing that it shall await the action of the Mother Country. If we do not act now, that clause will surely be repealed. We shall soon be left behind by the rest of the Empire—and can it be seriously questioned whether our internal trade is more important than our external trade? As Dr. Hunter vigorously pointed out, the question is a commercial one. It is not for us to choose—we must meet the wishes of our customers, and that quickly.

Our Export Trade with Spain.

We trust that British manufacturers and exporters, both with and without the assistance of the Foreign Office, which was recently organising a Spanish trade tour, are devoting a greater measure of attention to the possibility of developing trade with Spain. If they do not do so they may leave the Germans in possession of the field to a much greater extent after the war than was the case prior to the outbreak of hostilities. Some of the Spanish newspapers have already pointed out the gravity of the German danger to Spanish trade and industry, and suggested that prompt steps should be taken to meet the evil. It is estimated that, including the additions which have been made during the past two years, there are now 80,000 Germans in Spain, forming a nation within a nation, and being, in the words of the Madrid *Liberal*, an organised nation within a nation which is asleep. The newspaper also publishes extracts from an official document, which is stated to have been forwarded to one of the Allied Governments by "an illustrious sailor who had come to Spain as an official representative."

According to this extraordinary document, "the Germans who have sought refuge in Spain have profited by the frank and democratic nature of the people in order to introduce themselves everywhere and form friendly relations in particular with the provincial authorities, the mayors, military chiefs, naval commanders, officers of the gendarmerie, Custom House officials, and the heads of public services such as the posts and telegraphs, police, civil administrations, &c." As a consequence, it is affirmed that all diplomatic notes presented by the Allies receive evasive replies. "Practically, the Germans have all the Spanish services in their hands, and utilise them as they please. This organisation, to which the Allies have nothing similar to oppose, extends all over the country, and is particularly manifested in the ports. The refugee ships enjoy great liberties—the fruit of numerous kindnesses—and are the general quarters of the Germans." The document is held, further, to demonstrate that "Spain is a vast German naval base, favoured by the authorities of the country." It seems, the newspaper adds, "that the Government may at last decide to react. It can regulate the situation simply by applying the elementary rules of strict neutrality. As to the Allies, their action is inorganic; they are even incapable of directing, encouraging, and enlightening their Spanish partisans."

The fact that such a staid and respectable newspaper as *El Liberal* has given publicity to extracts from the remarkable document in question shows that the reality of the German danger is becoming recognised in the Spanish capital. It is unfortunate, however, that the Madrid newspaper has not presented any facts of its own—facts which must of necessity be known in Spain. It is to be hoped that our Madrid contemporary, and the other newspapers which have now realised the Teutonic danger, will investigate thoroughly the question as to the extent to which the Germans are endeavouring to secure control over Spanish natural resources. If they would also throw some light on the manner in which contracts are placed with German firms by the military authorities, the information would be of value in circles outside of Spain. At the same time, we must bear in mind that a considerable amount of German business in Spain has been done from stocks held in the country by branches or agents of German firms in different parts of Spain, with headquarters in Madrid. If British firms desire to have a large increase in their turnover with Spain, they will have to follow this example, either individually or in combination, since the larger orders generally pass into the hands of those who also carry out the small, or comparatively small, transactions, even in electrical manufactures and accessories, light railway materials, &c.

THE ROCHDALE CORPORATION ELECTRICITY SUPPLY UNDERTAKING.

The total capacity of the plant installed in the power house of the Rochdale Corporation amounts to 9,000 kw. The original equipment comprised three 1,000-kw. "Witton" turbo-generators driven by Howden turbines, these working at 5,800/6,600 volts, three-phase, 3,000 r.p.m.; while the later instalments of generating plant took the form of two 3,000-kw. "Witton" turbo-alternators coupled to Howden turbines, also running at the high speed of 3,000 r.p.m. The Howden turbines are of the pure impulse type, designed to give their output at a high efficiency, with a liberal margin of overload. The casing and diaphragms are divided on the horizontal centre line, the first three stages being arranged for partial admission and the later stages for all-round admission. The disks are constructed of special Siemens-Martin steel forgings, accurately balanced. The rim of each disk is provided with an inverted T-shaped slot to receive the blades and spacers, the gateway at which these are introduced being subsequently closed up by a patented process. The running clearances of the plates in both the axial and radial directions are approximately $\frac{1}{8}$ in.

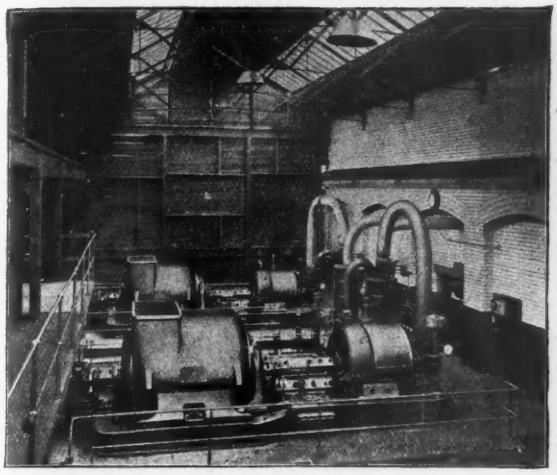


Fig. 1.—Howden-G.E. Co. 3,000-kw. Turbo-generators.

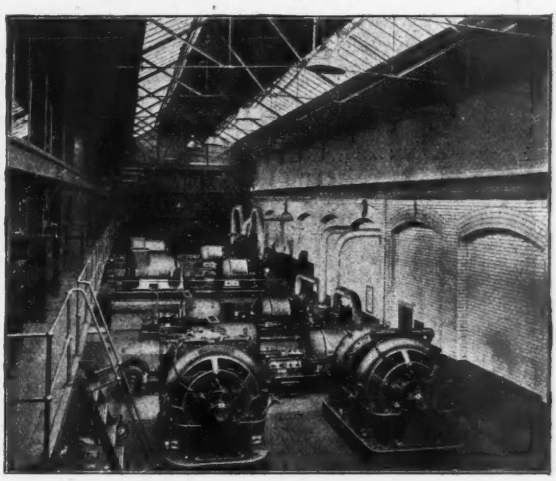


Fig. 2.—General View of the Rochdale Turbine Room.

As will be observed from the accompanying illustrations, continuous bedplates are provided to take the turbines and alternators. The oil tank is situated in the middle section of the bed-plate, and is equipped with a cooling arrangement which maintains the oil in circulation, and also the bearings at a very moderate temperature. A powerful governor is provided, and is driven by worm gear from the turbine shaft. By means of an oil relay acting on the throttle-valve, the governor controls the speed within very close limits, approximately 1 per cent. variation from full-load to no-load. The "Witton" alternators are of the General Electric Co.'s design and construction, having solid steel rotors with machined slots, in which the exciting conductors are laid, the mouths of the slots being subsequently closed by metallic wedges.

In the turbo-generators, as is usual in "Witton" machines, great attention has been devoted to the ventilating arrangements, separate cooling draughts of air being drawn in through wet air-filters by fans carried on the rotor shaft for cooling the rotor and the stator respectively. The windings are strongly braced, giving adequate protection against short circuits. The machines are liberally rated, as proved by the fact that both generators are frequently run by the Corporation with a load of 4,000 kw.

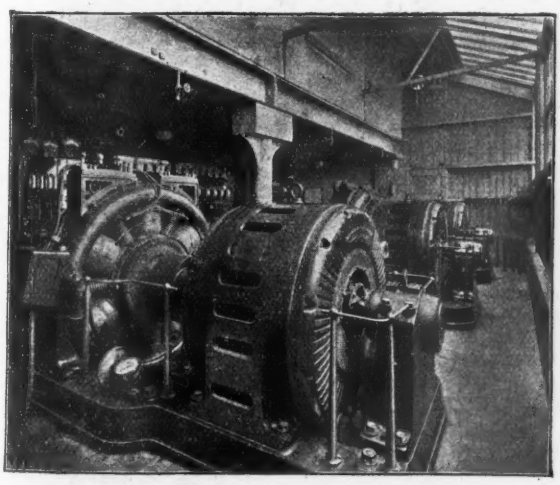


Fig. 3.—G.E. Co. 300-kw. Motor-generators in Sub-station.

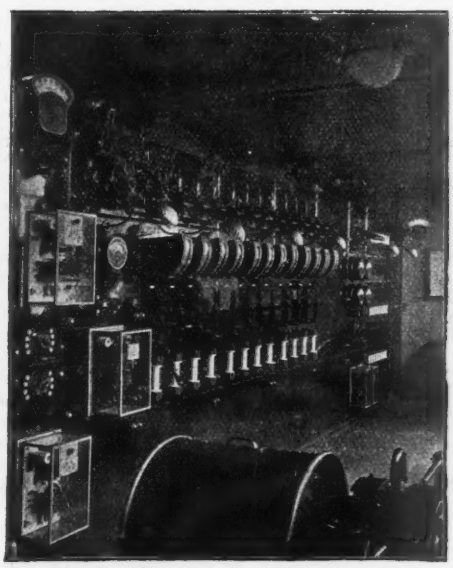


Fig. 4.—"Witton" d.c. Switchboard in Sub-station.

The station plant includes two 500-kw. motor-generators for supplying the local continuous-current requirements, the town mains being supplied at a pressure of 240—0—240 volts on the three-wire system; the machines can also be utilised to supply power to the tramway, at a pressure of 500 to 550 volts, through a change-over switch. These motor-generator sets are shown in fig. 2, and run at

a speed of 500 R.P.M., the motors being of the synchronous type.

The Rochdale Corporation has a number of outlying sub-stations for supplying various works, and a typical example of these is illustrated herewith. This sub-station contains three "Witton" synchronous motor-generators, running at a speed of 750 R.P.M., which are illustrated in fig. 3, while a view of the controlling switchboard distributing the direct-current supply to the works is shown in fig. 4.

The electrical generating plant for this installation was supplied by the General Electric Co., Ltd., of Witton, Birmingham, Messrs. James Howden & Co., Ltd., of Glasgow, being the main contractors and manufacturers of the steam turbines.

We are indebted to Mr. F. H. Rudd, A.M.I.E.E., the acting borough electrical engineer, for permission to publish these particulars and illustrations.

ELECTRIC FIRES.

By "HOT AIR."

"For each kilowatt-hour of electrical energy put into any type of electric heater, the same amount of heat is furnished. There may be some minor advantages in using one type of heater in preference to another type, but this advantage never consists in getting more or less heat units from a kilowatt-hour of electrical energy. This fact needs to be kept constantly in mind when discussing the advantage of electric heaters."—Prof. Osborn, in the *Electrical World*.

The theory that "all the heat which goes into a radiator must come out of it, and that therefore the efficiency of every radiator must be 100 per cent.," may pass muster in the lecture room; but without attempting to controvert any law like those of the Medes and Persians, I submit that in practice this equality is not apparent. Speaking from the experience of one who has this winter sold (not hired) 1,000 electric fires from a showroom displaying fires by 10 different makers, I submit that two fires can be produced, each with the same current consumption, giving results as dissimilar as a 16-C.P. carbon lamp taking 64 watts and a 60-watt metallic lamp. The laboratory experts' claim that the heat must come out does not concern the purchaser. When a 3-KW. fire of a certain well-known maker is put against a 2-KW. fire of another make, I will guarantee that five times out of six the 2-KW. fire will be preferred for actual radiant heat, quite apart from the saving in current consumption. Where does the heat thrown off by the inefficient fire get to? Does it lurk around the fire frame, or does it hover around the ceiling? Probably the latter; but as our fires are sold to human beings, and are not intended to benefit ceiling-walking flies or Mahommed coffins, the heat that gathers above the head of the average man is as good as wasted.

I can understand the cool reception given to "Experiment's" suggestions by the makers, because it is obvious that when one has to get a fire by a "well-known maker" sent on by rail when he succeeds in making a sale, his experience hardly warrants him in assuming the *rôle* of adviser, and his ideas are apt to be a trifle crude. Let him stock at least one or two of each of the various makers' fires, and he will, I suggest, discover that there are already on the market several fairly satisfactory designs. My own experience has been that makers gladly adopt any sane modification or suggestion put forward regarding their apparatus.

"Experiment" holds up the American manufacturers as models in this respect, but while I admit they are in a class by themselves for electrical table cooking appliances, irons, and vacuum cleaners, I find that we have nothing to learn from them in the matter of electric fires. This indiscriminate decrying of ourselves should cease.

I think most electrical men will agree that the experience of the past two winters has gone to show that heating by electricity has a greater future than some of the quidnuncs were wont to credit. Altogether, I should say the future is very hopeful. Prof. Osborn, already quoted, opines that for dwelling houses electric heating at 1 cent per KW.-hour costs three times as much as heating by coal (with coal at 30s. per ton), but this statement may be fairly put alongside of that of a speaker at the American N.E.L.A. that "the best electric water heater on the market is the coal stove." "Evidently," he added, "the Almighty didn't put enough calories into each kilowatt to make electric water heating feasible." Strange, indeed, that we should have to encounter this damning talk from electrical men. But the business will go ahead, in spite of these gentry.

PUBLIC ELECTRIC VEHICLE CHARGING STATIONS IN GREAT BRITAIN.

In view of the interest which attaches to the official list of charging stations recently published by the Electric Vehicle Committee, to which our readers are referred for full information in regard to charging facilities, tariffs, &c., and in order to stimulate those supply undertakings—still very numerous—who have as yet taken no steps to support the Committee in its endeavour to secure that such facilities shall be available wherever practicable, we have decided to publish the accompanying map indicating, as far as possible, the localities which are mentioned in the official list as offering charging facilities.

The practice of publishing route maps indicating where charging stations are to be found, is one which is followed by the New York Electric Vehicle Association in connection with its annual handbook of charging stations in New York City and vicinity, and one which our own Vehicle Committee might well adopt, either now or in the near future in connection with the metropolitan area. Our small inset map shows the position of London in regard to public battery charging stations, the main roads being indicated by dotted lines.

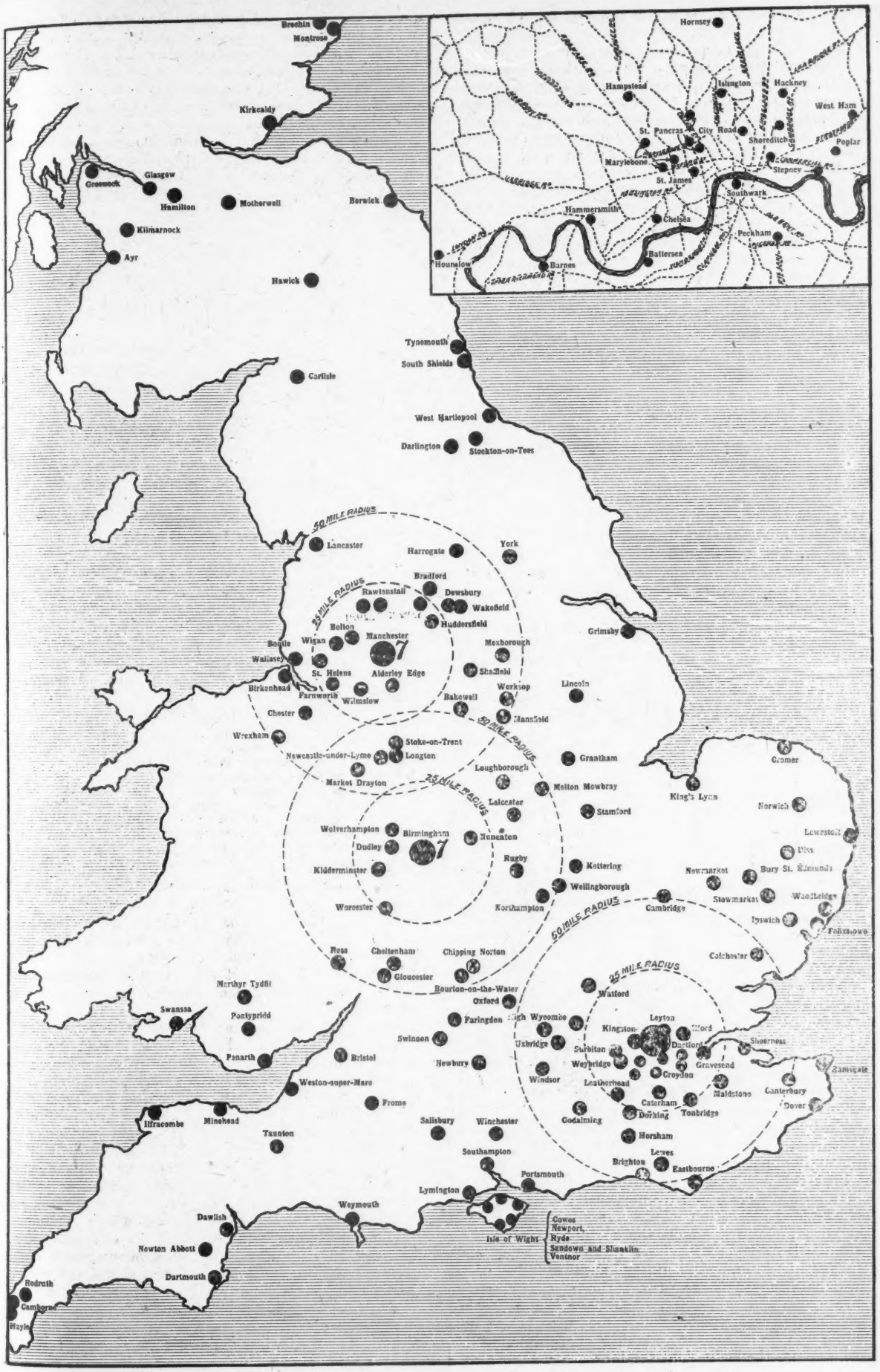
The stations are situated as follows:—

Barnes, High Street, Mortlake; Battersea, Lombard Road; Chelsea, 19, Cadogan Gardens; Southwark, Sumner Street; Clerkenwell, Graham Street; Peckham, 124, Hill Street; Hackney, Dalston Lane; Hammersmith, 85, Fulham Palace Road; Hampstead, Lithos Road, Finchley Road; Hornsey, Tottenham Lane; Hounslow, Bridge Road; Islington, 50, Eden Grove, Holloway; Poplar, Violet Road, Bromley-by-Bow; St. James (Westminster), Marshall Street, Golden Square; Marylebone, (1) Richmond Street, St. John's Wood, (2) Blandford Street, (3) Edison Acc., Ltd., Stourcliffe Street; St. Pancras, (1) Regent's Park, (2) Tavistock Place, (3) Highgate; Shoreditch, Whiston Street, Haggerston; Stepney, (1) 27, Osborn Street, Whitechapel, (2) Narrow Street, Limehouse; West Ham, Bridge Terrace, Stratford High Street.

The list is a modest one, all things considered, for such an ideal electric vehicle area as London, but we hope that progress under normal conditions will enable us to state in the not-distant future that, like the New York City Map, that of London is dotted with charging stations and garages.

On the question of garages, an American contemporary states that the Central Park Electric Garage, which is operated under the auspices of the New York Electric Vehicle Association (and which was illustrated and described in our issue of July 2nd, 1915), used during the year 1916 nearly 300,000 KW.-hours for charging purposes, and made more than 30,000 deliveries of, and calls for, cars. In February, 1915, when it opened, 77 cars were garaged; now that number has been practically doubled. Another contemporary from across "the pond" quotes Mr. Edison as deploring the lack of charging facilities as a hindrance to the growth of the electric vehicle business. He considered that central stations should go into the electric garage business because of the intelligent supervision which they can give, and suggested that they should sell electric current in the form of mileage, and perhaps rent out under contract the washing and repairing of vehicles at fixed and reasonable charges.

Mr. Edison is, of course, an enthusiast, but even so—having regard to his personal interest in the matter—his view that "the growth of the electric vehicle has been hindered by the lack of charging facilities," should carry



PUBLIC BATTERY-CHARGING STATIONS FOR ELECTRIC VEHICLES IN GREAT BRITAIN; CHARGING STATIONS IN LONDON SHOWN INSET.

considerable weight with electrical men on this side, and induce those who are in a position to do so, to provide such facilities when required.

Although battery charging facilities do not necessarily involve the establishment of a garage, the latter should always include the former, and, in view of the opposition of certain sections of the motor (car) trade to the proposed clause in the Bill to be promoted by the M.E.A., to enable appropriate charging and garaging facilities to be provided by municipal authorities, it would be interesting to learn whether these motor traders are willing themselves to install the requisite electrical charging plant, and to provide the necessary technical supervision.

Up to the present they have shown no disposition to do this, and were the electrical contractor a little more enterprising, we know of no reason why the sale, repair and garaging of electric battery vehicles should not remain in the hands of the electrical trader, instead of being tacked on, as a sort of side line, to the petrol-car industry.

A LARGE CARRON ELECTRIC COOKING INSTALLATION.

Through the courtesy of Messrs. Carron Co., we are able to illustrate some of the features of the apparatus, comprising a large installation of over 300 kw., which has recently been completed, also of other apparatus manufactured at their works in Stirlingshire.

Fig. 1 illustrates one of many electric ranges consisting of three standard ovens measuring 22 in.

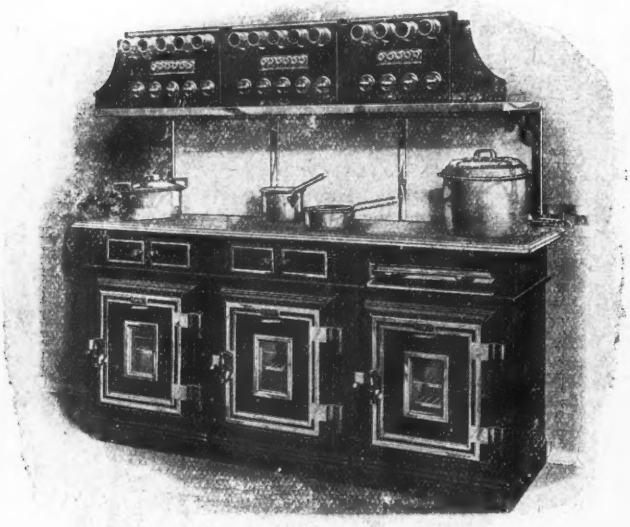


Fig. 1.—Range of Three Standard Ovens.

wide by 22 in. deep, by 20 in. high, constructed of cast-iron, with porcelain-enamelled steel linings throughout; it is double cased and heavily lagged, whilst the usual top and bottom heaters are fitted in all of them. Each oven is fitted with a toughened glass inspection window, and thermometer if required. The hobs on these ranges carry their standard fillings, of which there are two, each measuring 29 in. by 22¼ in., and another filling under which is mounted the grill. These fillings, which are machined quite flat, each have three boiling sections of various sizes and loadings, and the whole plate can be utilised for cooking operations, whilst, of course, the individual sections are working at a much higher temperature than the rest of the plate.

Some of these have been in operation over a year for many hours at a time, with very satisfactory results. The loadings of this range are: ovens 5.5 kw. each, grill 4 kw., hob fillings 6 kw. each, making a total of 32.5 kw.

At the back of the hob is mounted a white porcelain enamelled splash plate, on which brackets are fixed for carrying the switchboard which has been extended over the hob, thus making it much more convenient for the cooks to operate the switches. Each heating element is arranged for three heat series-parallel control by means of the rotary indicating switches, which, with the fuses and pilot

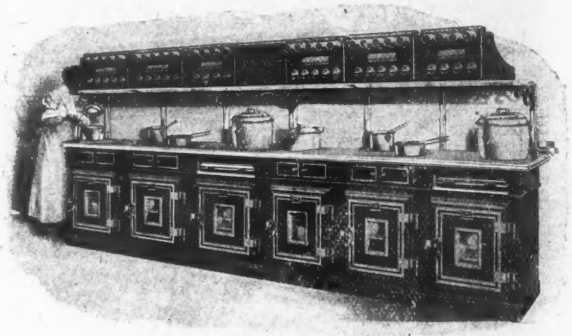


Fig. 2.—Large Carron Electric Cooking Range for Factory use.

lights, are mounted on the board. Also, the ruby glasses in the pilot lights have etched upon them the element or section corresponding to that which the switch beneath it operates.

The finish on four of these ranges installed in one particular factory engaged on Government work is bright nickel-plate and bright stove black enamel. Fig. 2 illustrates a bank of six of these ovens.

The Carron method of standard units of ovens, hob fillings, &c., lends itself admirably to extension and ready assembly on site, as well as handling for transit.

The hot closet illustrated in fig. 3 is one of eight installed in the same works as the ranges described above. Each measures 22 ft. overall in length by 2 ft. 9 in. high by 2 ft. 6 in. deep, and contains four compartments, with three shelves, all separately heated by standard interchangeable patent Carron elements. The bodies are of cast-iron, with mild steel sliding doors, whilst the linings and shelves are all of white porcelain-enamelled steel sheets with facings of half-round steel, nickel-plated, and polished.

Each section is rated at 5.25 kw., making a total of 21 kw. per hot closet, and the heat regulation is such that three heat series-parallel control is obtained in each shelf. In this case, the rotary indicating switches and fuses are mounted on the ends and in the centre of the equipment, the finish of which is bright stove black enamel, with hob and facings nickel-plated and polished.

The boiling table illustrated on fig. 4 is one of five in the same equipment, and is designed on the same principle as the standard fillings described in the ranges, the only difference being that they are cast in one solid piece, carefully machined quite flat on the top and the element receiving surfaces underneath.

These tables each measure 6 ft. long by 2 ft. 6 in. high by 2 ft. deep, and are arranged for seven rectangular boiling sections, which are shown in our view, rated at loadings varying from 2.5 to 1.2 kw., and giving a total of 17 kw. per table.

All the elements are interchangeable, and are readily accessible, but owing to the robust construction, renewals are cut down to a minimum.

Solid bus-bars are used for the main connections where possible, and heavy-gauge nickel wire for the

remainder, no loose beaded wires entering into their construction whatever.

On the back of the table is mounted a 16-in. cast-iron skirting, and over this is mounted the control

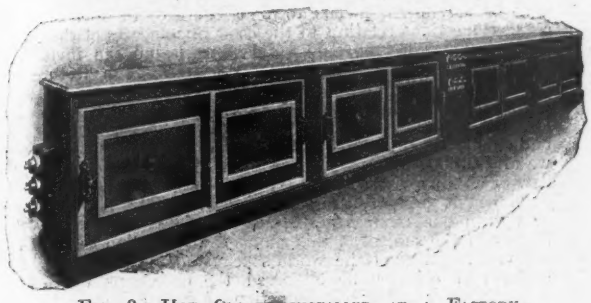


Fig. 3.—Hot Closet installed at a Factory.

board, which carries a rotary indicating switch to give three-heat series-parallel control for each section. These, along with the fuses and pilot lights,

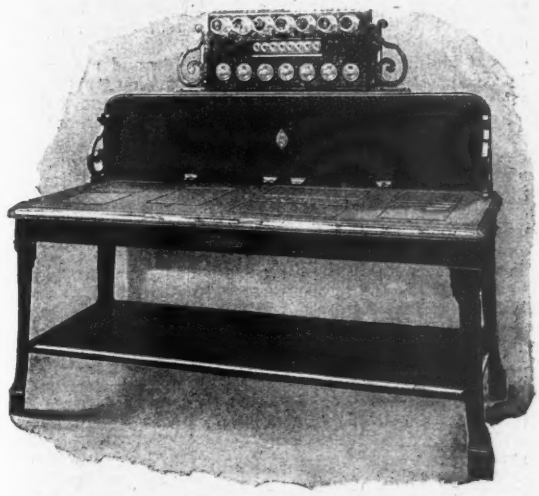


Fig. 4.—Boiling Table, showing Rectangular Boiling Surfaces.

with numbered etched ruby glasses to correspond with the sections, complete the equipment of a table. the finish of which is bright black stove enamel with nickel-plated and polished facing and mouldings.

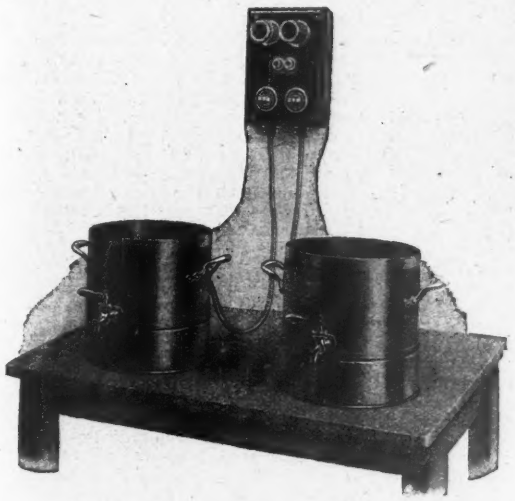


Fig. 5.—Electrically-heated Stock Pots.

Fig. 5 illustrates two six-gallon copper stock pots, each self-contained, and rated at a maximum of 5 kw. These are also wired up to the usual three-heat rotary indicating switches on a standard board.

In addition to the foregoing, a number of Carron standard independent 10-in. boiling disks are used in these kitchens, which are rated at 1.6 kw., and are self-contained, with the usual heat regulation. There is also a 6-ft. hot closet similar to the larger ones, and a 3-ft. boiling table similar to the larger one illustrated, only rated at half the loading, these bringing the total loading of the plant up to 332.8 kw.

The installation of this plant has been going on for over a year, and it has not yet been working at its maximum capacity, but the results so far obtained are very satisfactory, and will no doubt lead

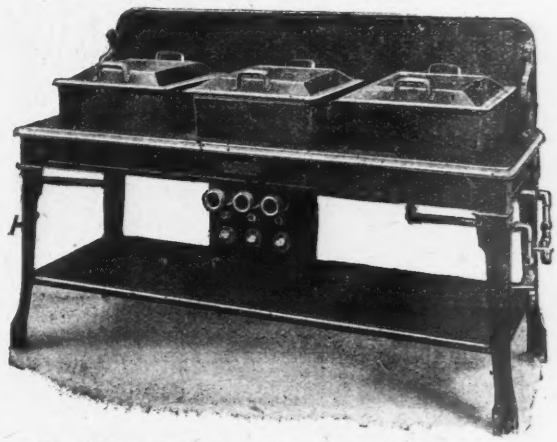


Fig. 6.—Electric Fish Frying and Boiling Suite.

to similar developments in other factories and works now that the welfare of the employés is receiving more attention at the hands of our industrial concerns.

In addition to this installation, the Carron Co. have, during the last two years, supplied equipment for kitchen and canteen installations in many con-

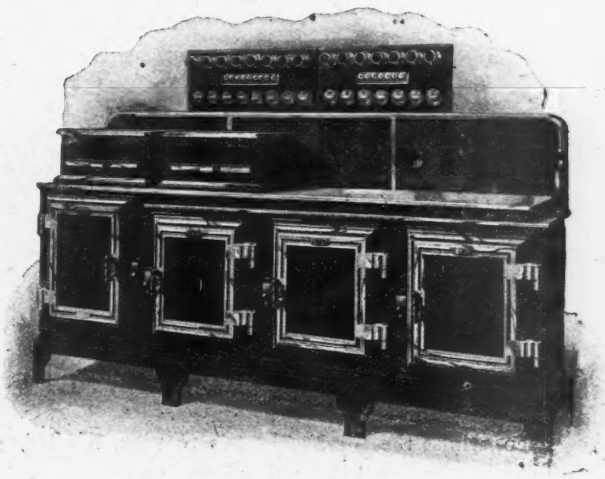


Fig. 7.—Cooking Range with Pastry Oven and Grills.

trolled and Government establishments throughout the country.

The fish frying and boiling suite shown in fig. 6 consists of three pans, each measuring 20 in. by 18 in. by 4½ in., fitted with wire basket, lid, and draw-off tap, and rated at a loading of 4 kw.

These pans are separately controlled by three-heat rotary indicating switches, mounted in cast-iron switch boxes, along with the fuses and pilot lights and fitted underneath the table. The switch boxes are built up on the elastic principle, and can be extended to any capacity required. A deep skirting is fitted at the back, and the total loading of this

D

suite is 12 kw., the finish being bright black stove enamel.

The range shown in fig. 7 is similar to the earlier ones described, except in capacity, and the addition of the grills. The smaller ovens are the standard size, loaded to 5.5 kw. each, whilst the larger one on the left-hand side is a

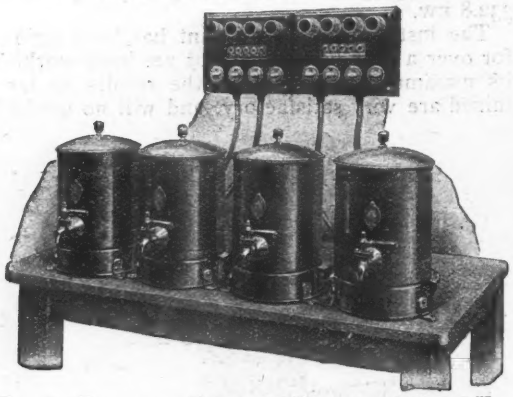


Fig. 8.—Battery of Electrical Boilers for Ships' Use.

pastry oven, having three compartments each measuring 22 in. wide by 22 in. deep by 8 in. high, all heated top and bottom, arranged for three-heat control, and the complete oven having a maximum loading of 5 kw. Over the ovens are two 18-in. grills, and a baking table for scones, &c., the loading of the grills being 5 kw. each, whilst they are arranged for various degrees of heat regulation. The baking table measures 4 ft. 6in. by 2 ft., and is loaded to a maximum of 10.5 kw., also being arranged for various degrees of heat regulation.

The total loading of the equipment therefore amounts to 42 kw., and the overall dimensions of the suite are 9½ ft. long by 6 ft. high by 2 ft. 6 in.

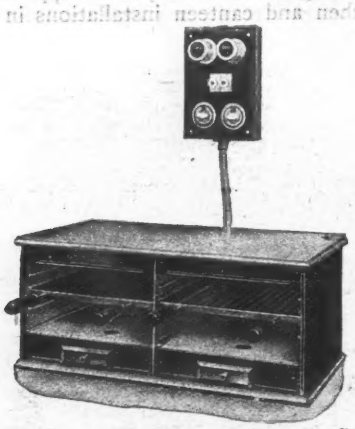


Fig. 9.—Double Compartment Electric Grill.

deep, whilst the total weight is 1½ tons, but being built in sections it is easily portable.

In fig. 8 we illustrate a battery of four five-gallon boilers, strongly but plainly made of heavy-gauge tinned copper; these are wired for 5 kw. each, and are arranged for various degrees of heat regulation. They are connected to a switchboard which mounts pilot lights and fuses in addition to the rotary indicating switches. These boilers have been specially made for use in ships' galleys, and are accordingly equipped with suitable swill ledges and strong lugs for fixing to the tables, whilst all the leads are enclosed in water-tight flexible metallic tubing.

The grill illustrated in fig. 9 is a double-compartment appliance, loaded to a maximum of 8 kw.; it has the usual fittings, and is finished in white porcelain enamel inside.

DECIMAL COINAGE AND THE METRIC SYSTEM.

In accordance with the decision of the Council of the Institution of Civil Engineers to hold a series of meetings to discuss questions relating to the economic aspects of the engineering industries, on Tuesday last week, on the invitation of the Council, Mr. Harry Allcock delivered a lecture on the decimal system of coinage, weights, and measures. The lecturer emphasised the necessity of preparing for the development of trade after the war, and remarked that international trade tended to follow the lines of least resistance; we must, therefore, smooth the ways in order to facilitate the flow of abundant trade to our workshops, and thus to provide employment and ensure prosperity in the future. Dealing first with our monetary system, Mr. Allcock traversed the history of the subject in this country, and, having shown that the vast majority of the world's peoples had adopted decimal systems of coinage, he discussed the objections which had hitherto prevented the introduction of such a system in this country, in spite of the persistent demands of chambers of commerce, municipal authorities, and other important public bodies for legislation to effect it. Comparing the various proposals that had been put forward, he expressed a strong preference for the adoption of the florin as the standard coin, divided into 100 cents, and showed that the values of the sovereign and half-sovereign, and of all our silver coins, would be unaffected, the only change being a reduction of 4 per cent. in the value of the penny.

Next taking up the subject of weights and measures, Mr. Allcock pointed out the defects of our existing "system," and the widespread adoption of metric units, and argued that any attempt at reorganising our existing standards without making them uniform with those of other countries would be futile. Every country which had reformed its units had adopted the metric system—never the British system. As for the United States, which was still non-metric, the manufacturers of that country had hitherto been engaged mainly in supplying the domestic market and English-speaking non-metric countries, and had not been seriously confronted with the problem. If we adopted the metric system the United States would be certain to do likewise—and the converse was equally true. Russia, the third important State that had not yet adopted the metric system, nevertheless employed it to a great extent; our adhesion to British measures greatly hampered commercial intercourse with that country, and Russian correspondents of the lecturer continually urged our adoption of metric units. It had been argued that we might adopt the metric system individually and by degrees; but, just as the "Daylight-saving" scheme was only made possible by making it compulsory, so it was impossible for individual firms to put themselves out of harmony with their neighbours in respect of weights and measures. By a canvass of engineering firms carried out by the Electrical Review in 1915, it was shown that there was a majority of 4 to 1 in favour of decimal coinage and the metric system, and a canvass carried out by the British Engineers' Association on a larger scale recently showed a majority of 83 to 87 per cent. in the same sense. Owing to a clause in the draft Bill, manufacturers were protected from interference with their plant and processes, and each could fix the date of change to suit himself, or continue to employ English units if he preferred. Existing patterns, &c., could continue to be used until they were worn out, when they could be replaced on metric lines. Mr. Allcock proceeded to read lengthy extracts from our last article on the subject (Electrical Review, March 23rd, pp. 313-316), showing that the workshop objections to the adoption of the metric system were largely based on misapprehension, that standards and tools need not be scrapped, and that the British Engineering Standards Committee's specifications would not be rendered useless by the change. He concluded by emphasising the importance of adopting metric units in design.

Opening the discussion, Sir Guilford L. Molesworth described how he had been instrumental in introducing the decimal system of coinage in Ceylon, in the teeth of influential opposition; although the population consisted mainly of Cingalese and South Indian natives, no difficulties were experienced in effecting the change; the results gave general satisfaction, and within six weeks the matter was forgotten. At a later date he had almost succeeded in bringing about the adoption of the metric system on the Indian State Railways, when political events intervened and prevented the consummation of his efforts.

Mr. Oliver Bury suggested that the advantages of the decimal system were obvious to members of that Institution, who probably used decimals more than any other profession. Many official reports had been presented in favour of the system, yet the Bills were thrown out by Parliament in spite of the mass of petitions in support of them. Was it due to conservatism, or to our having made money in the past too easily to be disposed to take the trouble of changing? But the times had changed. In the course of 16 years' residence in South America he had experienced the disadvantages of our existing systems, and he could not too forcibly impress upon his hearers the urgent necessity of learning the language and adopting the metric weights and measures—the two great factors essential to the maintenance of our trade with South

America. Spanish was now taught in London, and Portuguese was being provided for; but we must quote only in the metric system. He urged that a Member of Council should be deputed to impress upon the educational authorities the point that decimals must not only be *taught* in the schools, but also *learnt*—a very different thing. Finally, he suggested that a vote of the whole of the members of the Institution should be taken on the subject of the lecture.

Mr. C. P. Sparks (Pres. I.E.E.) said that these lectures on commercial questions were of the very greatest value, and the closer cohesion of the engineering societies must give the best results. The Council of the Institution of Electrical Engineers, in its recommendations to the Board of Trade Committee on the Electrical Industries, had advocated the compulsory adoption of the metric system. It was easy to see why the electrical industry was in favour of that system, but it could not be adopted sectionally, and the matter was primarily a trade question. If we were satisfied with our existing trade, there was no more to be said; but if we wanted the oversea trade, we were bound to have the metric system. Whether the United States or Great Britain took the initiative, the other must follow; let us, then, lead the way! The adoption of a universal standard system was quite feasible, and must make for the advantage of civilisation.

Sir A. Denny said he was surprised that 90 per cent. of engineers were in favour of the decimal system, but many people confused "decimal" with "metric" unnecessarily. Laplace stated that the metre was purposely chosen with a different value to any other measure to prevent jealousy; it would have been infinitely better if he had chosen the fathom. The original metric system had embraced many other matters besides weights and measures, all of which had been dropped. What would be forced upon us after metric weights and measures had been adopted? Why did not the metric people change the metre to 40 inches? Our inch was a good unit of length—why be hounded into changing it?

Prof. W. C. Unwin said he had no objection to decimal coinage, or the kilogram, but to change the unit of length would most seriously affect the work of engineers. As regarded foreign trade, five-eighths of the trade of the world was carried on by the United States and the Birtish Empire on the English system of units. Scientific men used the metric system because science was international, but it did not follow that it would be equally advantageous to engineers. The American Association for the Advancement of Science had formed an Association to promote the adoption of metric measures, but the American Society of Mechanical Engineers had formed an Association to defend the British units, and clearly America was not ripe for the change. He was informed that for trade with Russia there was no need to use any other than the English units; hence Russia was not ripe for change. In Japan the old units were in popular use, as well as the English units, except in the Army. The British Engineering Standards Committee, in translating its specifications into French, Spanish, and Russian, would place the metric values alongside of the English units; the Committee had also decided that certain metal sections should be standardised purely on the metric system. When our standard sections were first introduced, the Germans took steps to obtain identical sections from their rolling mills.

Mr. J. A. F. Aspinall cited Mr. Coleman Sellers's conclusion, after 20 years' experience of the metric system, that the system was not suitable for use in a mechanical engineer's workshop, and pointed out that Mr. Sellers occupied in the United States a position analogous to that of Sir Joseph Whitworth in this country. He had made inquiries as to the effect on different railway departments of the adoption of the metric system, and found that the change would involve a large outlay; all weighing machines would have to be altered, as well as all gas meters, and the tares of all wagons, private or railway owned. For this purpose 1,600,000 wagons would have to be weighed, and allowing 5s. per wagon the cost would be £400,000 for this purpose alone. The Metric Bill alone would not suffice to cover many points, which would require further legislation. It was proposed to develop trade with our Colonies, and, if we adopted the metric measures, should we not have to maintain a dual system? The question was whether our internal or our external trade was the more important; if the latter, that must settle the matter.

Mr. Ravenshaw remarked that of drawings which came before him some were in inches, some in millimetres, and some a mixture of both; in design it was important never to mix units—one or other system should be used, and if an exception was necessary, the dimension should be enclosed between brackets.

Mr. E. C. Barton said that Australasia had sent her premiers, not once or twice only, to ask us to do something in the matter, as they were sick and tired of the old units. Australia was not lagging behind; she had backed the decimal weights and measures. She had children to educate, and could not wait. He had been lecturing all over the country on the subject, but was wasting his time, for he found every meeting in favour of the change. The reason why Mr. Coleman Sellers and the other United States toolmakers opposed the metric system was because they were accused of being in league with Dr. Stanton, of the Bureau of Standards, to compel manufacturers to replace their tools, and they therefore declared themselves against the change.

Prof. Lupton said that the advocates of the metric system had failed to convince engineers and now sought to impose the system on them by compulsion. Once compulsion was started, where would it stop? He had nothing against the metric system, except that people tried to make it compulsory.

Mr. E. A. W. Phillips said it was difficult to work with vulgar fractions in the metric system. The metre was not international, being based on the Paris meridian, whereas the inch was the 500,000,000th part of the polar axis. We had a British metre of 39.6 inches directly descended from the old Belgian yard, and he saw no reason why we should change our units.

Mr. Monckton, whose remarks were almost inaudible, stated that the Japanese Navy was adopting metric standards, and that Russia employed them.

Dr. G. B. Hunter said he had not heard any arguments against the decimal or metric system. Our oversea customers wanted it—why should we not adopt it? The opposition was due to conservatism and old-fogeyism; whether the metre were right or wrong, we must adopt it eventually—it was the only unit that would help us as a trading nation. Let us be practical—where a change would do good, let us adopt it; where otherwise, leave it alone.

Mr. Hanson considered that the educational aspect of the question had not been sufficiently pressed. Millions of children were learning obsolete, useless tables, and it was a most serious matter; the time saved could be utilised for useful studies. In Russia the metric system had practically been adopted; there were four other systems in vogue, and all of them might be met with on the same drawing. He urged that we should come into correspondence with the rest of the world.

In reply to the discussion, Mr. Allcock welcomed the sound advice of Mr. Oliver Bury with regard to South America, which applied equally to other parts of the world. He had that day heard our system called the British "wastes" and measures. Mr. Sparks's support was evidence that electrical engineers were wholeheartedly in favour of the metric system. With regard to Professor Unwin's remarks, he stated that, in an American symposium on the subject, the mechanical engineers were the only body opposed to the metric system. In reply to Mr. Aspinall, he pointed out that the longer the change was delayed the greater would be the cost. If our external trade were not already more important than our internal trade, it certainly must be in the future if we were to survive. Mr. Ravenshaw's remarks were in favour of the use of a *single* system. The word "compulsion" seemed to be an obsession with Professor Lupton, but unless compulsion were accepted the present condition of dual measures must persist. With regard to Mr. Phillips's arguments, it was impossible to consider a third system. He was obliged to Mr. Monckton for his information regarding the Japanese Navy; China also was contemplating the early adoption of the metric system.

SOME POINTS IN CONNECTION WITH ENGINEERING SPECIFICATIONS.

The paper by Mr. J. Shepherd was read and discussed at a meeting of the Manchester Local Section of the Institution of Electrical Engineers on February 27th.

Mr. S. J. Watson said there were a number of difficulties in purchasing fuel on the calorific value basis. Although several collieries in the Lancashire district had been approached on many occasions, not one would enter into a contract for a supply on this basis. The percentage moisture varied very considerably with the same quality of coal, particularly the "washed-fuel" grade; in some cases this figure was about 15 per cent. Coal allowed to remain in railway trucks for some days during summer, for instance, would absorb 7 or 8 per cent. moisture. The grading of fuel on the basis of size had a considerable effect on the burning value, and the speaker suggested that the specification should provide for dividing up the fuel into definite sizes starting, say, with washed fuel at 1½ in. and going down to, say, ¼ in., or even smaller. With regard to cable conduits, undoubtedly for thickly populated districts with expensive excavations the "draw-in" system was the correct one; in other cases, however, cables laid on the solid system would give better results. The author's suggestion to allow extra-difficult work to be included in the total contract price, rather than to make provision outside the contract itself by means of a schedule, was a very valuable one.

Mr. G. D. Seaton said the best method of drawing up specifications was to define the conditions and results to be obtained, leaving the contractor to meet the requirements with standard products, if and when suitable. The lengthy general conditions in some bulky specifications suggested that many engineers were not aware how simply a satisfactory result could be obtained. In municipal trading rigid adhesion to the policy of accepting the lowest tender had been responsible for very serious losses.

Mr. S. Ferguson said a manufacturer should not be required to read through a lot of superfluous matter when preparing a tender. General conditions, for example, should be stan-

dardised on the lines laid down by the Institution of Electrical Engineers, thereby obviating the necessity of special attention. Municipalities would help manufacturers considerably if they deleted the 10 per cent. retention money on small contracts, say, less than £500. For quite large Government contracts for plant, full payment had been made after the final test. Regarding the technical requirements, switchboard specifications should be either (*a*) complete in every detail, including drawings or diagrams, or (*b*) a bald statement as to the plant to be controlled, leaving the manufacturer to offer the most suitable gear. An important item sometimes omitted from specifications was the current density in current-carrying apparatus. Specifications for oil-break switches rarely specified the inherent reactance of the plant to be controlled, and this was a vital matter; reactances varied from 2½ per cent. to 15 per cent., which meant that the duty imposed upon the former switch was six times that on the latter for the same size of plant. The system of inviting tenders as outlined by the author was not liked by manufacturers, on account of the fact that standard apparatus was not usually suitable, the design of the purchaser having to be adopted. This demanded special tools and, furthermore, it was quite conceivable that purchasers' designs would not take advantage of the progress being continually made. Government inquiries for switch-gear called for magnetic blowout circuit-breakers and knife switches without hinged contacts; both these requirements had been abandoned by leading manufacturers. The bill of quantities was very rarely included in present-day specifications.

Mr. W. Kidd said there was in many cases a preference for an intermediate course between the purchaser specifying in detail and simply asking for results; if carefully drawn up, intermediate-type specifications would obviate a tremendous amount of correspondence by giving the contractor details of conditions affecting the scheme. The guarantees should also be clearly stated. Purchasers should specify that curves showing effect of variation of such matters as steam pressure, vacuum, &c., in the case of turbines, temperature and humidity of atmosphere in the case of cooling towers, be submitted with tenders, otherwise the guaranteed results could not be checked. The method of test should also be specified. Trouble frequently arose from insufficient information as to accessibility of site, use of tackle, builders' work, &c. Pipe work and supports were matters for which the purchaser should take full responsibility. The general arrangement and principal dimensions of sub-station switchgear should certainly be standardised. Other points to be specified by purchasers were limits of current density and temperature rise, performance of transformers, and power factors of motors. A more general adherence to the B.E.S.C. specifications would benefit both purchaser and contractor.

Mr. Robertson said that no engineer would attempt to issue working drawings or draft close specifications for such items as turbo-generators, but if was essential to give a description of such plant and the nature of the tests to be applied, in order to prevent misunderstanding. The old-time procedure in regard to the detail in specifications was not at all necessary nowadays. Whilst he did not defend the biased conditions of contract issued by purchasers 10 or 15 years ago, he thought the B.E.A.M.A. conditions went to the other extreme and caused a good deal of trouble, which had not been altogether removed by the conditions of contract put forward by the Institution of Electrical Engineers. What was the object of advertising if only firms of ripe experience were to be selected? If this practice were adopted, each class of work would become confined to two or three firms and the smaller firms would gradually be frozen out. As experience had already proved, such a condition would result in being tied to standard designs and standard prices. Those who had been purchasing coal during the past few years looked upon the idea of purchasing on calorific basis as a vision quite unattainable at the present time. The principle was undoubtedly correct, but the market had to be properly educated to it. Some years ago he purchased coal on this basis from about 16 pits, but a coal agent offered to supply any quantity of coal from the same pits in certain proportions at 9d. per ton less than the colliery proprietors' agents offered, provided the calorific clause was dropped; the experiment was tried and found quite successful. This proved that the severe conditions in the specification caused the collieries or agent to put a margin on the price to safeguard themselves. Some 15 or 16 years ago a pipe system was laid down in a district adjoining Manchester, and in changing from low to high tension recently, cables and wall boxes had been withdrawn of sufficient value to pay for the new high-tension and sub-station mains. This was mainly on account of the rise in residual values. He did not consider it desirable to give public work on contract where the local authority was also the supply authority; it would probably pay in every case to engage a sufficient number of workmen or call in help from other departments. There was an unknown risk which the contractor had to cover when pricing his tender. A system of measurement such as indicated by the author meant constant supervision and checking, and even then disputes arose. There was still plenty of room for co-operation between purchaser and manufacturer, at least in standardising ideas.

Mr. J. Frith agreed with Mr. Robertson's criticism of the B.E.A.M.A. conditions, as they were certainly not to the advantage of the purchaser, and, in the long run, not to the advantage of the manufacturer. In the present state of the industry it was not always sufficient to state what was wanted and leave it to the manufacturer. The purchaser knew the local conditions which rendered certain methods of manufacture unsuitable, and in that case it was necessary to state both results and methods to be used in getting the results. In the specification for the purchase of coal it was not stated whether the higher or lower calorific value was used. The Institution of Civil Engineers had lately decided that the lower calorific value was to be used in power plant testing, also the lower value was to be the higher calorific value minus 1,055 times the moisture plus nine times the hydrogen in each pound of coal. The use of the lower calorific value was an admission that the moisture in the flue gases should not be condensed.

The Author, in reply, said it was an extraordinary thing that coal, of which there was an output of something like 300 million tons per annum in this country, was really the only mineral practically all sold without analyses. Regarding moisture, claims could be made against the coal dealer, but for every sixpence allowed the next tender would cover it. Mr. Watson said the percentage moisture varied according to mode of transit. This was not so, as coal conveyed by steamer showed a difference of 1 to 1½ per cent. after shipment, whereas the moisture in Yorkshire coal might be as high as 14 per cent. Regarding Mr. Seaton's view that the proper way to buy plant was to state views to the manufacturer and leave it to him to attain the desired result, engineers had their opinions on this point, and whilst many turbines had been specified and sold in this way the designer had not in every case acquired the knowledge to build reliable turbines. If exact requirements were specified, experience had shown that tenders could be accepted from unknown firms, provided the shops were visited in order to ensure that they had the tools and tackle to handle the contract. Regarding retention money, it was quite equitable wherever there was maintenance to retain a small proportion, say, 10 per cent., until the maintenance period expired. A point was raised about causing contractors trouble in making patterns and drawings. The contracts referred to never included less than two or three dozen articles. It might be the ideal method for the seller to supply standard articles, but when buying switchgear, say, 20 times, and getting 20 different types and sizes, the matter had a different aspect. It was surely up to the customer to pay for what was demanded. Regarding Mr. Kidd's valuable remarks on general conditions, British trade in the future was not likely to be built upon large documents, or even small documents like the B.E.A.M.A. conditions. It would have to be built on the system of trust and fair dealing, which had always been a criterion of British industry. Everyone would agree that the purchaser should get out his own pipes, otherwise there would be considerable trouble. The British Standard Specifications were all right up to a point, but they did not go far enough. The coal specification had worked successfully for 10 years.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Simplex Combination Pin Plug and Lampholder Adapter.

Messrs. Simplex Conduits. Ltd., of Garrison Lane, Birmingham, have introduced a useful accessory in the shape of a combined pin plug and lampholder adapter, illustrated in fig. 1, which enables a lamp standard, small heater, toaster, or suction cleaner to

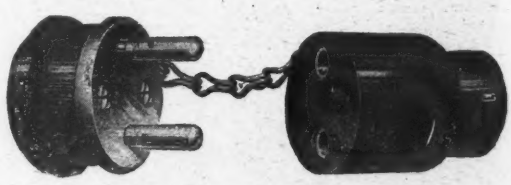


Fig. 1.—Simplex Combination Plug and Adapter.

be connected up to either a standard two-pin wall plug or a lamp socket, whichever connection is most convenient for the particular situation where it is to be used. The two parts of the combination are connected by a small brass chain. When used to connect any small circuit to a lamp socket, the combination converts the lamp socket for the time being into a two-pin socket, and the pin plug can be used to connect up in the ordinary way; if, however, temporary disconnection is required, the pin plug can be removed and remains ready to hand (suspended by the chain) for reconnection. It thus gives the convenience of a switch, breaking circuit on both poles, and the pin points are "dead," and therefore safe, after removal, no portion of the circuit remaining alive.

The adapter is substantially constructed, the lampholder attachment consisting of the brass connecting plugs moulded into fireproof material, or cocus wood, and the plug points being mounted on a china head with fibre disks for convenience in wiring. It is suitable for any temporary circuit up to 5 amperes at 220 volts, and is made in two sizes, to fit 3 and 5-ampere standard plugs and holders.

"Calorite" Electric Heating Apparatus.

A list recently issued by the British Thomson-Houston Co., Ltd., of Mazda House, Upper Thames Street, E.C., gives particulars of a wide range of lamp radiators, electric fires, convectors, irons, &c., of British manufacture. In electric fires, a large variety is shown, from the simple one-bar portable type loaded to 1 kw., for heating small offices, bathrooms and the like, to powerful fires taking up to 4 kw., and suitable for the largest apartments. The coil type fire-bars are of the Quead type, standardised at 1 kw., and

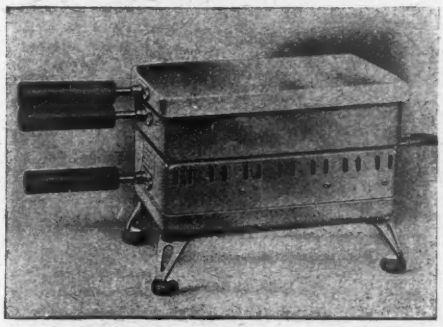


Fig. 2.—"Calorite" Radiant Grill.

can readily be renewed if necessary; the elements reach a red heat within a few moments of being switched on. Several forms of "Calorite" non-luminous and semi-luminous convectors are illustrated, suitable for use in entrance halls, corridors, public rooms, workshops and other places where no glow is required, and are listed in a number of forms. "Calorite" wire is used for the elements, the loadings ranging from 500 to 2,000 watts, according to size and type.

The famous "Calorite" flat irons are listed, covering all sizes of smoothing irons with "Calorite" elements, for both domestic and laundry use. The new "leaf" detachable heating unit is designed to heat the sole evenly without raising unduly the temperature of the handle and upper part of the body. Domestic irons are supplied in sizes from 4 to 8 lb., and with loadings from 400 to

Fig. 3.—"Calorite" Hot-Plate.

600 watts, the laundry models being made up to 18 lb., with proportionately higher ratings. For industrial and domestic purposes, "Calorite" hot plates and soldering irons are offered. The former is rectangular in form, and of cast-iron, mounted on four substantial legs, and fitted with elements loaded to 1,000 watts. Electrically-heated soldering irons operate continuously at the correct soldering temperature, and may be used out of doors without risk of cooling. Other useful devices listed include the "Calorite" radiant grill and toaster for table use, and the "Calorite" kettle. The radiant grill is an extremely neat and handy cooker, which may be used for grilling, toasting, stewing, or frying. The device, which is here illustrated (fig. 2), takes 600 watts only, and may be operated from any lampholder.

The kettles are listed for 2—4 pints, and are rated at 500 to 700 watts.

An Improvised Military Telephone Exchange.

This type of improvised exchange has been used in the battery, and has been found to work very well. It is made quite easily from very simple materials, which can be obtained always, says Lieut. W. P. K. Warren, R.A.G., in the *Journal of Artillery*. It is an eight-line exchange, and two telephones are used. The scheme of working is as follows:—

Referring to the diagram, fig. 4, strips of thin brass A are screwed to the base block, and have their ends bent up to clear strip B. Strips C are also screwed to the block, and are bent to clear strips A and also strip D. Contact between the various strips can be made by inserting a plug, of bent brass, at any of the points where the strips cross. Normally plugs are kept in all along bars B and D, and calls from the various stations are received in one or other of the telephones. The diagram shows the arrangement of the plugs when Billets is speaking Flank O. P.

They get no interference from other lines, and the battery exchange operator can tell when they have finished by putting in his plug to telephone now and again.

When shooting is in progress, and a clear line from a battery telephone to an O. P. (observation post) is needed, the other three

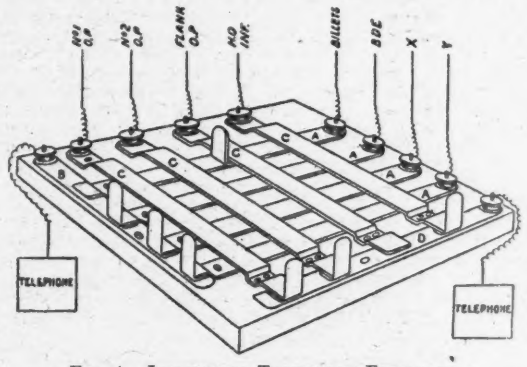


Fig. 4.—Improvised Telephone Exchange.

lines are transferred to the other telephone by moving their plugs up one place. Thus no line is, even temporarily, cut off.

The brass is cut from an 18-pounder cartridge case. The terminals come from worn-out telephone cells. The base is 8 in. square and ¼ in. thick, and should be well soaked in melted candle grease. The two terminals X and Y are used for the other section of the battery and the other battery of the brigade.—*Telephone Engineer.*

LEGAL.

Agreements with German Cable Companies Ended.

A series of motions for judgment in default of defence on behalf of the Eastern Extension, Australasia, and China Telegraph Co., Ltd., the Eastern Telegraph Co., Ltd., and the Europe and Azores Telegraph Co., Ltd., against the Deutsch-Niederlandische Telegraph Co. and the Deutsch-Atlantische Telegraph Co., which had taken over the business of the German Submarine Telegraph Co., came before Mr. Justice Coleridge in the King's Bench Division on March 29th.

Mr. R. O. B. Lane (instructed by Bischoff, Coxe, Bompas, and Bischoff), who appeared for the plaintiff companies, said the motions were all in actions brought for declarations that certain cable contracts and agreements with the German companies were void owing to the war, and should be terminated. The plaintiff companies took action after full consultation with the Foreign Office, and with their concurrence. No appearance had been entered on behalf of the defendants, though all proper steps had been taken.

His Lordship made an order in each case as asked, terminating the contracts and agreements.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Decimal Coinage.

Having read the able article in your issue of the 23rd inst. with much interest, I venture to suggest some simplification of the scheme proposed for the reform of our coinage.

Why should we not simply retain the sovereign and its tenth part, the florin, as proposed by the Electrical Review, but, instead of importing such a very un-English coin as the cent, continue to use the half-florin, or shilling, and make ten pennies go to a shilling instead of twelve?

The useful sixpence could still be retained, but it would have to be called "fivepence" instead. The half-penny would also be retained, at the rate of 20 to a shilling.

Crowns, half-crowns, four-shilling pieces, and even the ecclesiastical threepenny-bit should be abolished, as they only tend to confuse foreign visitors (and even natives), and give an enormous amount of unnecessary trouble in banks and counting houses where large quantities of cash are handled.

Farthings should be abolished. It is difficult to see what is the use of a farthing to a country that spends six and a-half million pounds a day on war. They are merely a nuisance; the product of the "retail mind," which ought to be scrapped along with them.

The change-over would be simplicity itself; the scrapped silver coins would be called in, and re-struck into florins, shillings, and

five-penny pieces. The copper would also be called in, and pennies and half-pennies re-issued the following day at the rate of 10 and 20 a shilling respectively, instead of 12 and 24.

Steps would, of course, have to be taken to prevent enterprising persons from accumulating copper for the rise in value. That would present no real difficulty.

Retail shopkeepers might scream, but all they would have to do would be to consider the enhanced value of the penny and the halfpenny when writing out new price tickets on the next weekly turn of the profiteering screw. Incidentally, the delusion that the draper makes only a farthing per yard on materials sold at, say, 11½d., would disappear. The advantage of this scheme would, I venture to submit, be enormous. In the first place, the retention of the penny would save from the scrap heap all the existing penny-in-the-slot meters, telephone apparatus, toffee machines, automatic weighers that won't weigh, and other plant. The system would have British characteristics, but, at the same time, it would be a true decimal system lending itself to every operation of arithmetic and book-keeping with the greatest facility.

I venture to assert that it would have a definite effect on the number of our allies and friends visiting this country after the war, who would no longer have to add an extraordinary and mystifying coinage to the other difficulties of our strange land. At the same time, unless I am ignorant of some important factor, the scheme presents the very minimum of difficulty or delay in its adoption.

G. W.

[We welcome our correspondent's letter ; but would his scheme really retain the *penny?* He takes the "5-cent" piece and calls it the "penny," but the change in the value of the nominal penny would be 20 per cent. increase, whereas the 4 "cents" would have a value only 4 per cent. less than that of the existing penny. We are unable to agree that a smaller coin than a halfpenny is unnecessary.—Eds. Elec. Rev.]

WAR ITEMS.

Prohibited Imports and Exports.—Proclamations signed on March 30th, prohibiting a large number of imports and exports, appear in the *London Gazette* for March 30th.

Trading with the Enemy.—The "London Gazette" for March 30th contains a list of additions, &c., to the list of bodies and persons with whom trade is prohibited in Argentina and Uruguay, Brazil, Chile, Colombia, Netherlands, Spain, Sweden, &c.

From Bangalore.—A Lieutenant with the Forces at Bangalore writes:—"The Review reaches me regularly each week, and it is always a pleasure to dip into its pages and so keep in touch with familiar names and associations, and all that goes on at home affecting electrical interests."

Hong Kong and Enemy Trading.—A Press dispatch states that the Hong Kong Chamber of Commerce at the annual meeting passed a resolution confining membership of the Chamber to British subjects. Resolutions were also passed favouring legislation limiting Government orders to British firms, for the prevention after the war of revival of the use of enemy trade-marks, and opposing the return of enemy subjects to the colony.

The British Trade Corporation.—In reply to a question in Parliament, Mr. G. H. Roberts, M.P. (Board of Trade), said that Lord Faringdon had been invited to proceed with the formation of an institution on the lines recommended by his Committee on Finance and Trade after the War. The preliminary steps had been taken, and the British Trade Corporation would very shortly be formed under Royal Charter. The object of the Corporation would be to afford credit facilities for British trade, especially in cases falling outside the scope of existing banks and banking houses.

Pre-War Contracts.—The President of the Board of Trade has appointed Lord Buckmaster (Chairman), Mr. C. S. S. Guthrie, Mr. Lennox Lee, Mr. F. D. Mackinnon, K.C., Mr. Walter Raine, Mr. F. G. Rice and Mr. T. Worthington to be a Committee to consider and report on the position of British manufacturers and merchants after the war in respect of contracts entered into by them prior to the war with persons or companies in the United Kingdom or in Allied or neutral countries, the fulfilment of which has been prevented or impeded by the war, and as to the measures, if any, which are necessary or desirable in this respect.

Exemption Applications.—At Swindon, the Corporation Tramways Committee appealed for a brake-fitter (33), passed in B1. Mr. A. Dimmack, electrical engineer, said that the Army had failed to find a substitute, as hoped. He had a "scratch" staff now, and it was very difficult to carry on the work. Two months' exemption granted.

At Stoke-on-Trent, Mr. W. Thorn, manager of the Potteries Electric Traction Co., reported that he had agreed with the Military authorities to release 21 men in Class A, who are to be released when substituted. Lieutenant Malkin said that arrangements had been made with the Army authorities for the return to the company's service of skilled men who were not in the higher categories, and as these returned the Class A men would be released. The Tribunal acquiesced in the arrangement.

At Northallerton, the Electric Light Co., Ltd., appealed for a member of the staff, and the secretary intimated that if the man was called up the only alternative would be to close down. Exemption was granted until a substitute is provided.

At Chatham, the Tramway Co. appealed for four motormen, a switchboard attendant, an assistant overhead lineman, the chief clerk, and a storekeeper and traffic clerk. The manager, Mr. W. Jensen, said that the lineman had been passed for general service, although he had a withered hand. The chief clerk and one motorman were each exempted until June 1st, and the others were directed to serve when substitutes were provided.

Rawmarsh Tribunal have granted conditional exemption to a tramway switchboard attendant (21), three motormen, and a stoker and repairer engaged at the tramway depôt.

At Shipley, F. Buckle, an employé of the District Council electricity department, was exempted till July 31st, and T. Hull, an employé of the same authority, was given till September 30th.

At Burnley Tribunal, Mr. Starkie, electrical engineer, appeared in support of the claims for three switchboard attendants, two aged 21, the other 19, and also for an apprentice electrical engineer, aged 18 (all single men). Mr. Starkie stated that his staff had been reduced to an absolute minimum, and he considered it would not only be undesirable, but dangerous if any more were taken unless they were substituted by practical men. The Chairman said the three men were very young. The electrical engineer stated that they were very capable; they had control of the switchboards and were approaching the end of their apprenticeship. They were badged men, and held trade cards. The Chairman said if the men still retained their badges and trade cards they would not be called up. Mr. Starkie withdrew the appeals of the three switchboard attendants. The claim respecting the 18-year-old apprentice was non-assented.

At Brighton, the Military had a review made of conditional exemption allowed to five employés at the Corporation electricity works. The engineer stated that 83 men had enlisted from the works, and the present staff was about 180, as against 220 or 230 before the war. A fuseman (33, in Class B1) was given a final month; a fitter's labourer (38, B1), two months; a labourer (37, C2), a switchboard attendant (40, C1), and a wireman (33, C2), four months each.

At the Shoreditch Tribunal, a firm of electrical engineers and contractors appealed for the second time for J. Green, aged 37, an electrical fitter, class C3. He was engaged on important electrical work, and such men were very scarce nowadays. The Tribunal decided that, in view of the man's classification, he would be much better engaged in carrying on electrical work, which was undoubtedly of national importance at the present moment. The Tribunal granted six months, and advised Green to try to do V.T.C. drills.

COMPARISON OF ELECTRIC WINDING SYSTEMS.

A recent issue of the *Colliery Guardian* contained an abstract of a paper on the above subject, read before the South African Institution of Electrical Engineers, by Mr. S. E. T. Ewing, from which we reproduce the following extracts:—

Sufficient experience is now available with both alternating-current and Ward-Leonard winding plants to make it evident that either type can economically and safely carry out all the present requirements of main winding engines, and that definite advantages appertain to each type, making each commercially and technically preferable under given circumstances. The principal operations which main winding engines are required to perform are: Shaft sinking; winding from one level; winding from several levels; raising and lowering men; lowering timber, pipes, drills, and general machinery and supplies; dead slow winding for shaft and rope examination, repairs, &c. All these operations are normally carried on in balance, *i.e.*, with both drums clutched to the driving shaft. Operations which usually necessitate out-of-balance running, *i.e.*, with one drum unclutched, are: Taking off, turning end for end, or renewing main and tail ropes; adjustments for stretch of ropes; alterations of rope lengths for drawing from different levels, &c.

Apparently only one deep level shaft has been sunk with electric plant, viz., the Cinderella Deep South Shaft. The obvious danger inherent in electric winding in relation to shaft sinking is the possible failure of power after the lighting up signal for blasting has been given. At the Cinderella, where direct three-phase motors were used, the difficulty was got over by the use of a synchronous machine coupled to a flywheel floating on the winder bus-bars, which was put into commission at blasting time. Ward-Leonard plant, with the Ilgner flywheel arrangement, would, of course, equally well

meet this difficulty. Further, the adoption of electric blasting would remove the difficulty entirely. Main winding at the present purchased price of power on the Rand being admittedly far more economical than steam winding, the economic advantage of sinking with electricity is patent, provided the load factor of the plant does not fall too low.

The economy of the Ward-Leonard system when winding from one level is greater in so far as the acceleration losses are smaller, and, further, if and when the speed-time curve for the wind involves braking in order to secure a rapid retardation near the surface, this braking is performed regeneratively. On the other hand, the economy of the alternating current plant is greater in so far as it has no motor-generator losses. Hence the relative economy under the same mechanical conditions is a function of the frequency of winding. The important point to bear in mind is that while the maximum frequency of winding is limited and defined by the general conditions, the average may be much lower, and it is therefore essential, if a proper comparison is to be arrived at, to estimate this average correctly. It is obvious that the lower the frequency of winding, the greater the gain to the alternating current, and conversely, the higher the frequency the greater gain to the Ward-Leonard. For example, it has been found that the consumption per hour is equal for the two engines discussed at a frequency of 12.5 trips per hour, the maximum frequency being 30, and the average 25.

Assuming that the estimated frequency of winding is sufficiently high to show a clear gain for the Ward-Leonard in power consumption per ton hoisted, it then becomes necessary to consider whether the capitalised value of the power saved is sufficient to cover the additional capital cost of the Ward-Leonard equipment, which would presumably in all cases be in the neighbourhood of 50 per cent. in excess of the alternating current equipment. In general, a winder is operated steadily for a spell of perhaps seven or eight hours, with an idle spell of four to five hours, twice daily.

Experience has shown that the maintenance cost of both types of plant is quite small relatively to that of a steam plant. Other things being equal, the Ward-Leonard plant, with its two large sets of brush gear and commutators, entails more maintenance than the plain induction motor of the alternating current plant. On the other hand, a certain amount of attention is required by the forward and reversing switches and liquid controller of the latter.

From the point of view of safety in winding, neither type offers any marked advantage over the other. Relative ease of handling for winding depends mainly on whether the conditions do or do not require a reversal of the direction of torque on the drum shaft. The simplest condition, most favourable to alternating current control, is the case where uniformly balanced running is secured by means of a tail rope, and at the same time the energy of the moving system is recovered by shutting off power and allowing the engine to "run out," timing the moment of shutting off so that the skip comes to rest in the tip with a minimum application of the brakes. Several large alternating current winders are running under these conditions, and the ease of control leaves nothing to be desired. The contrary condition is that in which no tail rope is used in a deep level shaft, and consequently the weight of down-going empty skip and rope exceeds, at and below a certain point in the shaft, the weight of the full up-coming skip and rope. To tip the skip then necessitates a reversal or torque on the drum shaft, or the application of the brakes. The brakes merely waste energy, and in the case of the alternating current plant a reversal of torque means a corresponding dissipation of energy in the controller. On the other hand, with a large Ward-Leonard control, the negative work is absorbed regeneratively and with perfect ease of control.

The most important point arising from winding from several levels relates to the necessity for frequent clutching and unclutching of drums. The difficulties arising therefrom apply equally to alternating current and the Ward-Leonard plant.

Under ordinary conditions it is not practicable to assure an up-coming load of men to balance a down-going load. Hence, in cases where a large number of men have to be handled, the Ward-Leonard system, on account of its regenerative properties, shows a distinct gain in economy. In a particular case, where approximately 900 men form the complement on one shift, a single Ward-Leonard winder using three-deck cages holding 60 men, and lowering the shift in one hour to 3,800 ft., the net input of energy over the hour is practically nil, the regenerated energy sufficing to wipe out the motor generator and winding motor losses. Raising and lowering men present no particular difficulty to the alternating current plant, but where a large complement is handled the Ward-Leonard plant has a clear economic advantage.

The regenerative property of the Ward-Leonard again offers an advantage where, as in large mines, the quantity of timber, pipes, rails, and drills lowered is very considerable, and is always in excess of the weights of drills raised. One, if not the greatest, source of trouble with the earlier alternating current plants arose out of this matter of lowering. It is, of course, perfectly feasible to lower at synchronous speed, and also to apply reverse current when braking, but designers appear to some extent to have overlooked the fact that under the latter conditions a large amount of additional energy has to be dissipated at the controller. Overheating and flashing over at the latter resulted. The alternating current plant is essentially less economical than the Ward-Leonard when lowering at less than the synchronous speed, and in practice only a small portion, if any, of a lowering trip can conveniently be done at synchronous speed.

Again, no difficulty arises in practice in dead slow winding for shaft examinations, &c., with either type of plant. On the score of ease of handling, the Ward-Leonard has the advantage, because a definite speed, however slow, corresponds to a definite position of the controller lever, whereas in the case of the alternating current plant the liquid controller is sensitive and subject to fluctuations in resistance at low speeds. On the score of economy, the Ward-Leonard is greatly superior, the input being practically proportional to the speed, whereas in the case of the alternating current the input during slow winding amounts to nearly the same as would be required for full-speed winding over the same period. As ropes are examined at least monthly, and shafts at least weekly, and the operation in each case for a 4,000-ft. shaft occupies an hour or more, this latter becomes of some importance.

Every winding engine should be capable of raising its full-rated skip or cage capacity when working single drum, *i.e.*, *unbalanced*. The motor must be capable of exerting the full necessary torque under unbalanced conditions, both to be in accordance with the regulations for safety, and also in order to be able to perform various operations in connection with the replacement of ropes, both main and tail. As these operations are comparatively infrequent, there is a natural tendency to cut down the size of the motor to a point where it can only perform this work under rather severe overload conditions. When this is the case, the alternating current is apt to give trouble at its weakest point, the liquid controller, and the Ward-Leonard probably at the corresponding weak point, the commutator of the motor generator. Anything of this kind which renders probable the opening of the main control switch on overload is apt to be exceedingly dangerous, because at the moment the power fails the engine is supporting its maximum unbalanced load; and an accident can only be averted by the holding power of the brake on one (the clutched-in) drum. It is obvious that this kind of underestimate of the conditions cannot occur in the case of plants that run normally without tail ropes, as do several of the largest electric winders on the Rand. The point is one of considerable importance. The even turning movement of an electric winder renders the use of a tail rope (which is apt to sway with the uneven turning movement of a steam winder) a perfectly simple proposition, and its use naturally reduces the peak load with a corresponding reduction in the motor rating. On the other hand, it has to be borne in mind that the design of the plant must allow of sufficient torque being developed to raise the full unbalanced load without any signs of overstrain. In the case of the alternating current, owing to the large overload torque possibilities of the induction motor, compromise is not difficult, and resolves itself mainly into an extra large controller. In the case of the Ward-Leonard plant, it seems doubtful whether full security under maximum torque conditions is compatible with the considerable reduction in rating which the use of a tail rope renders possible under normal conditions.

The foregoing remarks apply to the conditions on a number of mines, where the depth is between 3,000 and 4,000 ft., and the tonnage hoisted is not greater than 160 tons per hour. The new deep level shafts will attain depths considerably over 4,000 ft. At such depths it is difficult to secure the minimum requisite factor of safety in hauling ropes, and therefore the pros and cons of two-stage winding are likely to come again under discussion. Further, the additional power required tends to place the single large direct-connected induction motor out of court, owing to the excessive size and low-power factor. Mechanical reduction gear for these large motors is, as far as Rand practice is concerned, quite untried. Altogether, therefore, it may be assumed that a new and highly-interesting series of problems still lies before the designers of electric winding plants, and that finality in size and design has by no means yet been reached. The following summarises such of the foregoing remarks as refer to direct comparison of the alternating current and Ward-Leonard systems under different conditions:—

Conditions.	A.C.	Ward-Leonard.
1. Shaft sinking	Equally effective on all points at approximately equal capital cost.	
2. Rock winding from one level		
(*a*) With tail ropes	Relative economy dependent on frequency winding. Lower capital cost. Equal safety and ease of handling	
(*b*) Without tail ropes	Lower capital cost	Superior economy over all. Easier to handle.
3. Rock winding from several levels	Lower capital cost	
4. Raising and lowering men	Lower capital cost	
5. Lowering supplies	Lower capital cost	
6. Dead slow winding	Lower capital cost	

AN INTERNAL-COMBUSTION TURBINE.

In view of the importance to the electrical engineer of any device offering a prospect of solving the problem of the gas turbine, the following particulars, by Mr. A. W. H. Griepe in *Power*, should be of interest :—

The machine described is rated at 100 h.p., and has made a number of runs. The results so far obtained, it is stated, are promising, an efficiency of about 20 per cent. having been indicated by a rough test.

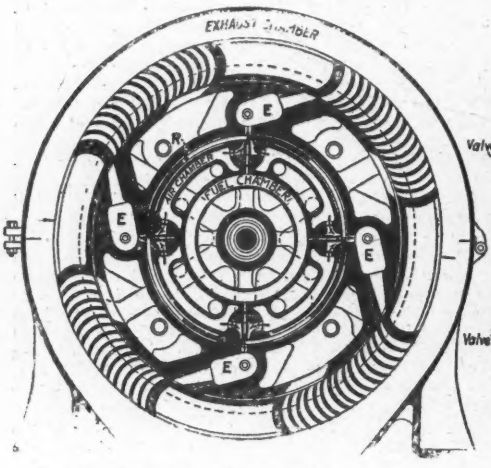


Fig. 1.—Position of Turbine Wheel at Beginning of Admission.

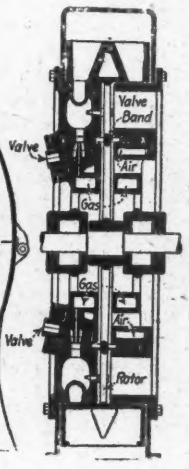


Fig. 2.—Longitudinal Cross-Section of Turbine.

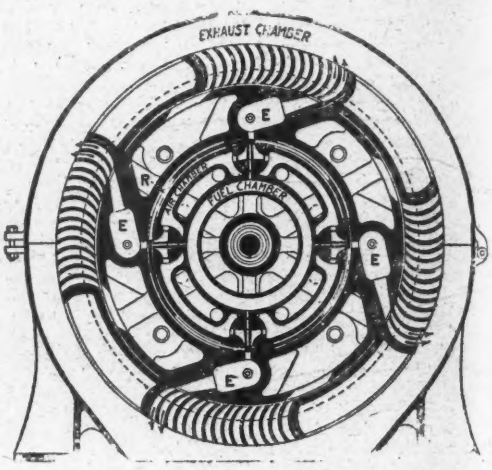


Fig. 3.—Position of Turbine Wheel at Beginning of Expansion.

The turbine consists of a rotor similar to that used in a reaction type turbine, with the blades distributed in four equally spaced groups around the periphery of the wheel. Each group occupies one-eighth of the circumference, as shown in the cross-sectional views, figs. 1 to 3. On the rotor is mounted a valve band R, also shown. The band acts as an admission and cut-off valve between the explosion chamber and the fuel and air supply. The stationary element contains the explosion chamber, also the ring chamber for the fuel and air supply, as shown in figs. 1 and 3. It will be seen that the nozzles are mounted so that the gases flow from the inner to the outer periphery of the wheel.

Compressed air enters the air chamber from the storage tank at from 45 to 75 lb., and the gas from the fuel chamber at approximately atmospheric pressure. In fig. 1 the wheel is in a position where the nozzles leading from the explosion chamber to the blades are closed and the ring R has opened the admission from the fuel and air supply to the explosion chamber. The compressed air flows in through the passages indicated by the curved arrows. In doing so it acts as an injector, and draws the fuel in through the small straight nozzle in the centre of each valve, as indicated by the straight arrow. This continues until the wheel has revolved to the position shown in fig. 3. Here it will be seen that the ring R has closed the passage between the fuel and air supply and the explosion chamber, and that the port is open between the explosion chamber and the turbine blades. The valve ring closes the port between the fuel and explosion chamber an instant before the port is opened from the explosion chamber to the blades, and at this instant the charge is ignited and expands from the position of the wheel in fig. 3 to that in fig. 1. The ring R opens one side of the air valve before the gas valve opens, and the nozzle from the explosion chamber to the turbine wheel does not close until the gas valve is opened ; this allows a charge of air to be blown through the explosion chamber, which scavenges it and prevents back-firing.

The turbine is in duplicate, with the nozzles on one side displaced in angular position by one-eighth of a revolution from those on the other side, so that when one side is in the expansion stage the other is taking in a charge in the explosion chamber. This gives approximately a constant turning effort on the turbine wheel.

The operation of the turbine may be explained from the

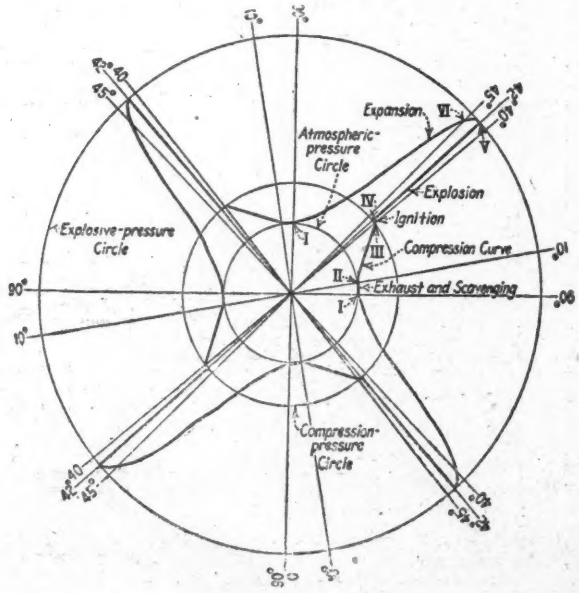


Fig. 4.—Cycle Diagram.

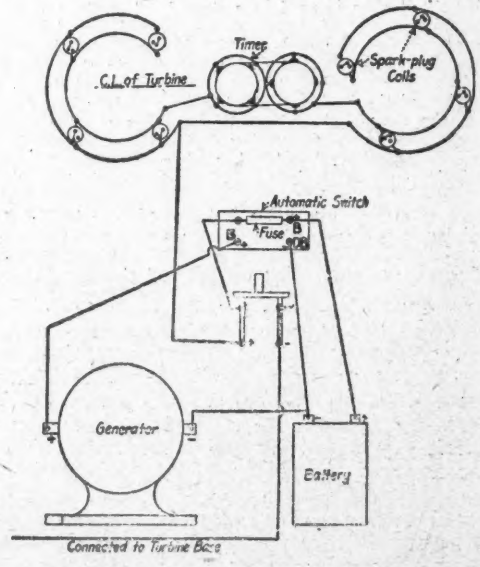


Fig. 5.—Wiring Diagram of the Ignition System.

cycle diagram in fig. 4, as follows :—Starting at I, expansion is complete and the ring valve is just beginning to open the air valve, with the explosion chamber still open to atmosphere. Air is admitted to the explosion chamber, blows out through the exhaust and scavenges the explosion chamber. This continues for 10° of the revolution, as indicated, at which point the nozzle from the explosion chamber is closed by the inner rim of the rotor. At point II the valve band R opens the fuel valve, admitting a fresh mixture into the explosion chamber, and the pressure rises, owing to the pressure of the compressed air. At III, 40°, the valve band closes the admission opening. When the valve band has overlapped 1° at IV, 41° to 42°, ignition takes place. At this point the highest pressure is obtained, V. From 42° to 45° the nozzle is opening from the explosion chamber and expansion begins. From 45°, VI, to 90° the nozzle is wide open and expansion takes place. At 90° the cycle is complete and begins over again. As no complete data were available for the quantity of compressed air necessary, it had to be determined by experiment. The first installation was a 3 × 4-in. Gardner compressor. The amount of air delivered was large enough for two explosion chambers, one on each side, the least number of chambers the turbine can be throttled down to. The air leakage between the tank and the explosion chamber was at that stage about 25 per cent. This loss proved to be too large, and adjustable nozzles were installed, as shown in figs. 1 and 3. This reduced the losses to about 10 per cent.

A 6 × 6-in. double-cylinder Curtis compressor was then installed, and proved sufficiently large to run the turbine, producing 85 to 90 H.P. at 2,500 R.P.M. The loss of air by leakage was still 9 per cent. A floating valve was next installed near the valve band opening in the explosion chamber (not shown), and the leakage or loss was reduced to the following figures :—With tank pressures of 50, 60, and 75 lb., the pressures in the explosion chamber with the nozzle closed were 48, 57, and 70 lb. (gauge) respectively. The power necessary to compress the air was about 15 per cent. of the whole power developed, and later was improved to 12 per cent.

The combustion, it is claimed, never gave any trouble. When starting, the pressure on the fuel was about 3 lb., but after a short run the mixing valve acted as an injector and forced the fuel into the explosion chamber by suction, thus making a carburetter unnecessary.

A heating coil in the exhaust base heats the fuel to a high temperature, thus assisting in vaporisation. The turbine has been operated with two, four, six, and eight explosion chambers in action. By turning the mixing valve 45° and switching the spark plug coils out, the relative explosion chambers become active or inactive, thus saving fuel and current when the full output of the turbine is not needed.

The vane-blade sections are made of cast-iron and inserted in the rotor. They have stood the various trial runs well. The sections are cast in one piece, and can easily be replaced by simply lifting the exhaust hood without disturbing the whole unit. The thickness of the blade ranges from $\frac{1}{8}$ in. near the edge to $\frac{1}{4}$ in. in the middle. Fringing occurred only on places where the core left a very thin edge, due to irregularity in the loam core.

The electrical equipment—the ignition system, the part of the turbine that apparently would seem the easiest of all—nearly proved a stumbling block. Several experts recommended schemes that took up considerable space, but none of them proved successful. However, the inventor of the turbine, by using spark-plug coils, four on each side, successfully solved the difficulty. This did away with the lag in the current, and has proved entirely satisfactory. Current is supplied from a battery while starting. After the turbine comes up to speed, an automatic switch throws the sparking system over on the generator and the battery on charge.

The wiring for the sparking system is shown in fig. 5. The current produced by the generator is conducted through the automatic switch, where one circuit goes through the battery and keeps it charged, while a second circuit leads to the spark-plug coils and the timer. The timer is made up of eight contact points, each representing an explosion chamber. The points are alternately connected, four for either side. A separate circuit from each of the rings leads to the plug coils, so it will be seen that the rollers make the contacts for four coils simultaneously. This arrangement proved successful even up to a speed of 3,500 R.P.M.

BUSINESS NOTES.

For Sale.—A two-ton Edison electric omnibus is offered for sale by the Loughborough Road Car Co., Ltd., as announced in our advertisement pages to-day.

Electric Vehicle Sales.—According to the *Commercial Motor*, the Jowett Motor Manufacturing Co., of Bradford, has received a repeat order from the Bradford electricity department for two more five-ton G.V. vehicles ; the Bootle electricity department has ordered two similar vehicles, and the Manchester electricity department one such vehicle. Other sales of G.V. electrics have been to Mr. J. B. Wilkinson, a local chemical manufacturer, and to the Low Moor Iron Co. (repeat), these being for 3½-tonners, which size of vehicle has also been sold to Messrs. Robinson and Peel, of Dudley Hill, in this case for wool cartage. Messrs. A. Priestman & Co. have brought a two-tonner, and other users in the district include the Lingfield Dyeing Co., Messrs. Lister and Co., and Shaw & Co. (Shipley), Ltd.

A Leigh Canteen.—We have received a copy of a brochure issued by Callender's Cable and Construction Co. Ltd., as a souvenir reprint of the opening of a canteen at the Anchor Cable Works, Leigh, in November last. The speeches are given in full, and there is a description of the canteen. Interesting photographic groups appear of the directors and their wives and the officials present at the ceremony, also one of the staff ; another shows the canteen itself.

Book Notices.—"A National System of Economics." By J. Taylor Peddie. University of London Press, Ltd. Price 5s. net.

"The Driving of Machine Tools." By T. R. Shaw. London : Scott, Greenwood & Co. Price 4s. net.

"Electrical Equipment." By H. W. Brown. London : Hill Publishing Co. Price 12s. 6d. net.

"Electric Traction." By A. T. Dover. London : Whittaker and Co. Price 18s. net.

Machinery Prices in Germany.—It is announced that the 10 firms working together in the matter of prices have just decided to raise from 40 per cent. to 75 per cent. the amount charged as extra prices on machines made with metallic substitutes (iron and steel and zinc., &c.) for copper.

Capital Expansion in Italy.—The Dinamo Hydro-Electric Works, which belongs to the Brown-Boveri group, is increasing its share capital by £200,000 to £1,000,000, for the purpose of extending the works on the southern declivity of the Simplon, and acquiring hydro-electric works on the Ariza. A real wave of activity in promotion is reported to be proceeding, particularly in regard to the electrical, chemical, engineering and shipbuilding industries.

Liquidation.—Simplex Insulators (Bourke's Patent), Ltd.—This company is winding up voluntarily, with Mr. J. W. F. Grahame, 56, Moorgate Street, E.C., as liquidator.

Catalogues and Lists.—The date under the Order relating to the dispatch of catalogues, price lists, and trade circulars has been extended to April 21st in cases where their production was actually begun before March 3rd.

Siluminite Insulator Co., Ltd., 16, Dowgate Hill, Cannon Street, London, E.C.—Leaflet giving particulars and prices of "Siluminite," a new insulating material.

Messrs. Siemens Bros. Dynamo Works, Ltd., Caxton House, London, S.W.—48-page brochure, containing exhaustive particulars of their own rotary converters and information of a general nature concerning this class of machinery. Electrical and mechanical specifications of the Siemens converters are given, and the largest section in the book deals with special characteristics of rotary converters. The brochure is fully illustrated by means of diagrams and excellent half-tone pictures.

LIGHTING AND POWER NOTES.

Aldershot.—The proceeds of a 1d. rate are to be set aside in the ensuing half year to meet the estimated deficiency on the electric light undertaking for the year ending March 31st, 1917.

Australia.—The Railway Department has commenced the erection of a new electric power house at Newcastle East, N.S.W. The present plant supplies power and light to the Walsh Island and Honeysuckle Point workshops, the basin cranes, and wharf, and light to the dyke ; in view of the increasing demand for electricity for both power and lighting for present services, and the further supplies which will be necessary when the grain elevator and additional cranes, &c., are erected, it was found necessary to increase the plant. The power house will also supply energy for the tramways when they are electrified. The new building

will at first supply light and power for all the services except the tramways, as the electrification of the tramways is not likely to be put in hand for some time.—*Sydney Daily Telegraph.*

The Brunswick (Vic.) Council has decided to borrow £5,000 for the extension of the electric lighting and power system in the municipality.

Bristol.—Price Increase.—At a recent meeting of the Electrical Committee the following additional advances were made:—7½ per cent. on lighting, 15 per cent. on power, and 12½ per cent. on the combined rates, making a total advance on the basis price as follows:—Lighting, 22½ per cent.; power, 45 per cent.; combined rates, 37 per cent.

Chester.—Proposed Loan.—The T.C. has adopted the recommendation of the Electricity Committee to apply to the L.G.B. for sanction to borrow, as a matter of urgency, the sum of £11,500 for cable and the construction of a sub-station.

Chile.—Senores Sougarret Hnos. y Compania has been granted permission to install an electric lighting system, by means of overhead cables, in the town of Ercilla.

Don Luis E. Silva is also authorised to complete the installation of electric lighting in the towns of Llolleo and San Antonio.—*Board of Trade Journal.*

Chippenham.—Price Increase.—The Electric Supply Co. has informed the B. of G. that from April 1st next the price for current supplied to the workhouse will be advanced by ¼d. per unit.

Clonakilty.—Price Increase.—The local Electric Lighting Co. has applied to the Council for an increase in the annual payment made to the company for the public lighting of the town, owing to the increased cost of materials and labour. The increase asked for is 15 per cent. on the amount now paid. The Council is at present paying about £109 per annum.

Eastcotts.—The B. of T. has forwarded to the Bedford R.D.C. sanction for the supply of current to new works by the Bedford Corporation.

Finchley.—A discussion took place at the last meeting of the U.D.C. on a motion that no payment be made to the Electricity Committee in respect of arc lighting, which should be discontinued. Eventually an alternative motion was carried to discontinue arc lighting and for the Electricity Committee to allow the Highways Committee 1d. per unit for all current saved owing to the alteration of the lighting arrangements.

Glasgow.—Electricity and Town Planning.—Councillor Denny has given notice that he will move, at the T.C. meeting, the following resolution:—"That the Corporation, being of opinion that, for domestic purposes, electricity should be substituted, wherever possible, for other means of lighting, heating and cooking, direct the attention of those engaged in considering 'the housing problem' to this resolution, especially the architects who have been appointed to town plan the city; and, further, ask the Dean of Guild and his Court to exercise their influence and powers to secure, in new buildings, wiring of sufficient strength to permit, in addition to lighting, the installation of heating and cooking appliances."

Hebden Bridge.—Bulk Supply.—The heavy demand upon the local Council's electrical plant, and the difficulties of installing additional plant at present, have caused the Electricity Committee to take a supply of current in bulk from the Halifax Corporation, subject to a satisfactory agreement being reached, to augment the local supply. The Council did not feel justified in putting down a further oil engine in view of the present price of oil.

Ilford.—The Electricity Committee has revised the tariffs for electric supply as from the readings for the quarter ending June.

Keighley.—In seconding the Electricity Committee's minutes, at the T.C. meeting, last week, Mr. Wardle congratulated the Committee on its enterprise since last month in stopping the waste of coal which had formerly gone on at the electricity works. It was now impossible for the coal to drop down into the cinders. Mr. Sellars, on behalf of the Committee, appreciated Mr. Wardle's remarks, but added, "I should like to say we did look into the matter, but we have not made any alterations for six months."

The T.C. has accepted a recommendation by the War Bonus Committee for the payment of a war bonus of 5s. per week, and 6d. per week for each dependent child under 13, to all employés of the Council over 21 years of age, commencing April 1st, and continuing to three months after the declaration of peace, provided the bonus shall include and be in substitution for any bonus already granted by the Council. The bonus, however, is not to be paid to any official in receipt of a salary exceeding £200 per annum; any clerk or official or female employé who has been appointed since April 1st, 1916; any clerk or official or workman who has received an advance of salary or wages in lieu of war bonus, except to the extent by which the bonus now granted exceeds the amount of such advance. The Council has been paying roughly just over £2,000 a year in bonus and allowances, and the new scale will practically double that amount.

Lancaster.—Price Increase.—On Thursday last week, the T.C. approved the Electricity Committee's decision to increase the charges for lighting and power by 22 per cent, and for tramways and 'buses by 12½ per cent.

London.—L.C.C.—The Finance Committee recommends the sanction of the Council to the borrowing of £1000 for electricity purposes for the Battersea B.C.

St. Marylebone.—The Electricity Committee reports that certain economisers require renewing, at a cost of £2,000, and recommends that the work should be put in hand as soon as possible.

Londonderry.—Loan Inquiry.—A L.G.B. inquiry will be held on April 13th into the application of the Corporation for sanction to a loan of £35,500 for the electricity undertaking.

Mexborough.—Proposed Loan.—Mr. J. B. Feltham, electrical engineer to the Urban Council, has reported on the proposed extensions of the plant. The Committee has instructed him to proceed with specifications. Sanction is to be asked to a loan of £9,500. The recent electrification of a local factory is largely responsible for the pressure, and the consumption there is rapidly increasing, while the demand for power current generally, apart from this mill, is greatly increasing. The Electricity Committee did not accept a suggestion by the Yorkshire Electric Power Co. of a bulk supply.

Spenborough.—Price Increase.—The Council has decided to advance charges all round as from May 1st. For ordinary power consumption the price will be 2¼d. per unit, with the discount remaining as at present. For lighting the charge is increased to 5½d. per unit, and the discount reduced to 2½ per cent.

TRAMWAY and RAILWAY NOTES.

Australia.—Train Lighting.—The question of lighting the country trains by means of electricity has been under consideration by the Victorian Railway Commissioners for some time. At present on some lines kerosene is used, and it is on these that steps are being taken to use electricity, as the use of Pintsch gas necessitates the transport of the gas cylinders for recharging. A set of Vickers' train-lighting equipment has been obtained, and is to be given a trial in the local service between Heidelberg and Hurstbridge, where the cars are equipped for kerosene lighting.—*Melbourne Age.*

Blackpool.—Electric Vehicle.—The Corporation Finance Committee has decided to purchase an electric motor chassis for the removal of fish offal and household refuse, at a cost of £750. It is stated that the use of the vehicle will effect a saving to the Cleansing Committee of about 1s. 6½d. per ton, as compared with the cost of removal by horse-drawn vehicles. The Corporation already has electric road-sweepers, collection carts, and watering vans.

Bradford.—Year's Traffic.—The aggregate receipts of the Corporation tramway department for the 357 days of the current tramway year are reported to have been £341,772, an increase of £12,006 over the receipts for the corresponding period of last year, which comprised 359 days.

Coventry.—Tramway Expenditure.—At the last meeting of the City Council, Ald. Drinkwater said the Tramways Committee had submitted estimates for an expenditure of £350,000 on the tramways.

Keighley.—Railless Traction.—At the T.C. meeting, last week, a member pointing to a decrease in railless traction receipts of £36 for last month, suggested that, in view of this and the dearness of railway fares and the bad train service, the fares should be increased 25 per cent., which, he held, would convert the £36 decrease into a £25 increase, and with the increased revenue the service could be enlarged. It was explained, in reply, that the Committee had no power to increase the fares, and if they were not already at the maximum they were not far off. In reply to further questions, Mr. Albert Smith, on behalf of the Tramways Committee, said the great obstacle to the proposed through tramway route between Keighley and Bradford, *via* Bingley, was Stock Bridge, which must be widened before a tramway extension there could be thought of.

Leeds.—Year's Traffic.—The tramway returns show that the receipts up to date, for 52 weeks, have been £497,377, an increase of £38,898 on the figures of the same period of the previous year. The total of passengers carried has been 2,129,000.

Manchester.—The City Council, last week, approved increases of salaries to officials in the tramways department, totalling £158; a proposal that salaries should not be increased until the end of the war was defeated.

Mexborough.—The Mexborough and Swinton Tramways Co. has announced that cheap fares will operate only before 7 o'clock in the morning and between 5 and 6 o'clock in the evening, except Saturdays, when the return times will be between noon and 1 o'clock. Miners are the people mostly affected; men who travel less than a mile will have 6d. per week more to pay.

Preston.—At the Council meeting, on Thursday last week, regarding criticisms that it would have been better if the Committee had dealt with the demand for increased wages locally, Ald. Ormrod said the one or two towns who originally backed out had found that it had not been to their advantage. Preston had decided to act in conjunction with other tramway authorities, as it was obviously to the advantage of the town and the men themselves that there should be uniformity in wages and conditions of labour.

U.S.A.—A subway is proposed for St. Louis, Mo., and the city is to be asked to consent to its construction. The cost is estimated at $8,000,000, and it is proposed that the United Railways shall operate it, and repay the city for the improvement from all earnings over 6 per cent. An elevated railway is said to be impossible in St. Louis, but the subway would do much to meet the city's requirements.—*Electric Traction.*

Further reports on the extension of electric traction by the Great Northern Railway, which is proposing to equip a 150,000-H.P. hydro-electric plant on the Chelon River, show that the company is scheming to electrify its coast lines between Vancouver, B.C., and Portland, Ore., a distance of over 500 miles.

TELEGRAPH and TELEPHONE NOTES.

A Lofty Tower.—According to the *Journal Télégraphique*, quoting from *Annales des Postes, &c.*, an American company proposes to erect at Longalang the highest tower in the world—307 metres in height, or 7 metres higher than the Eiffel Tower. This tower will be used for wireless communication with a station at Buenos Ayres, for which the Government of Argentina has already granted a concession. A powerful installation on the improved Poulsen system will be laid down, and the work should be completed within a year.

Glasgow.—The Post Office authorities have made arrangements which will have the effect of considerably accelerating the telephone service between the Glasgow and a few neighbouring telephone areas on the one hand, and the Edinburgh telephone area on the other. The new service was to be inaugurated on April 2nd. Subscribers' calls will be dealt with exactly as in the case of local calls.

Long-Distance Wireless.—A new wireless station has been established at San Diego, a port in the extreme south of California. The apparatus is so powerful that the station will be able to exchange messages with Melbourne.—*Melbourne Age.*

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—U.D.C. Electricity Department. Battery of accumulators, complete. See "Official Notices" March 16th.

Australia.—MELBOURNE.—May 23rd. Victorian Railways Department. Twelve months' supply of incandescent electric lamps as ordered.

Aylesbury.—Electricity Department. 200-KW. direct-coupled internal-combustion engine and generator, fuel plant and accessories. See "Official Notices" March 30th.

Hull.—April 12th. Electricity Committee. Cooling towers. See "Official Notices" March 23rd.

London.—ST. PANCRAS.—April 12th. B.C. Arc lamp carbons. See "Official Notices" March 9th.

Salford.—April 9th. Mild-steel trays for coal elevator, for Electricity Department. Borough Electrical Engineer, Frederick Road.

Warrington.—April 11th. Electricity and Tramways Committee. One 3,000-KW. turbo-alternator and surface condensing plant. See "Official Notices" March 16th.

April 11th. Electricity and Tramways Committee. Motors and transformers. See "Official Notices" March 23rd.

CLOSED.

Australia.—Water and Sewerage Board. The following tenders were received for two steam turbines and condensers for Ryde Pymble pumping plant :—

British Westinghouse E. & M. Co., Ltd.	£12,569
Fraser & Chalmers, Ltd.	13,956
Willans & Robinson, Ltd.	13,505
Price, Martyn & Co.	13,952
Australian G.E. Co.	14,700
William Adams & Co.	15,144
" (alternative)	14,729
A. Harvey & Phillips	17,420

The engineer-in-chief has reduced these tenders to a common basis, f.o.b. England, and recommends the tender of Messrs. Fraser and Chalmers as the most favourable.—*Sydney Sun.*

Ilford.—U.D.C. Annual supplies :—

Incandescent lamps.—Crypsleo, Ltd., and Electrical Manufacturing and Supplies, at present prices; London & Rugby Engineering Co., Ltd., at prices quoted.

Joint boxes and fuse boxes.—W. Lucy & Co., Ltd., on sliding scale, in accordance with prices of copper, iron, and porcelain at time of order.

The tender of Messrs. E. Foster & Co. has been accepted for 10,400 tons of coal at the following prices :—

5,400 tons Ibstock medium peas, 20s. 4d. per ton.
1,500 tons Ibstock D.S. nuts, 22s. 4d. per ton.
2,000 tons West Cannock 2-in. nutty slack, 21s. 4d. per ton.
1,500 tons Ibstock nutty slack, 18s. 8d. per ton; or, failing this, Ibstock D.S. nuts, 22s. 4d. per ton.

London.—L.C.C.—The Highways Committee recommends that it be authorised during the Easter recess to open any tenders that may be received for transformers, &c., for the Greenwich generating station.

Walthamstow.—U.D.C. Lighting Department. Annual supplies :—

Dussek Bitumen Co.—Jointing material.
Chamberlain & Hookham, Ltd.—Meters.
Electrical Manufacturing & Supplies.—Lamps.
Vacuum Oil Co., Ltd.—Oils.

Tramways Department :—

W. Wood & Co.—Trolley heads.
Anti-Attrition Metal Co.—Trolley wheels.

For the erection of a chimney shaft at the electricity works the tender of Messrs. Custodis, Ltd., at £1,143, is recommended.

FORTHCOMING EVENTS.

Association of Mining Electrical Engineers (West of Scotland Branch).—Saturday, April 7th. At 4.30 p.m. At the Royal Technical College, Glasgow. Annual meeting.

Institution of Electrical Engineers.—Thursday, April 12th. At 8 p.m. At the Institution of Civil Engineers, Gt. George St., S.W. Discussion on "Wayleaves," with introductory paper by Mr. C. Vernier.

Salford Technical and Engineering Association.—Saturday, April 14th. At 7 p.m. At the Royal Technical Institute, Peel Park. Paper on "The Hydraulic Press," by Mr. J. Bacon.

NOTES.

Welfare Study.—We have received from the Special Intelligence Branch of the Ministry of Munitions of War a copy of a brochure on "Welfare Study," written by Mr. Cecil Walton, manager of one of our large National Projectile Factories, from first-hand knowledge. In a prefatory note "V.B.S." explains how the secret of promoting union between all classes, which he had sought before the war without avail, was revealed to him on active service at the Front—it was simply the fact that "the British officer has thoroughly inculcated into him that *his first duty is the care and welfare of his men.*" This is the lesson which we must learn to apply in our industrial life. The author, by way of introduction, declares that welfare work has come to stay; "apart from all question of general or individual comfort, *it pays*"; moreover, it will be found a most fascinating study. He proceeds to explain what it is; that it is not confined to women only, it does not merely mean "canteens, and chairs, and pianos"; it is the study of mankind, the introduction of the humanising element into manufacture. This is the keynote of the work, and we may point out that it is also the characteristic feature by which British civilisation, as evidenced in the war, is distinguished from the brutal "Kultur" of our chief enemies, the Prussians.

Welfare is essentially the business of the general manager, whose principal function is to choose correctly suitable subordinates and to provide an efficient organisation, pervading the whole factory, so that the head can keep in touch continuously with the trend of feeling amongst the staff and workpeople of every rank. An atmosphere of mutual assistance must be created, and antagonism dispelled. The study of fatigue is the next step; the appointment of a wholly competent and sympathetic female welfare superintendent is essential; an ambulance room must be provided; the question of clothing must be studied, and suitable over-all garments *provided*; a comfortable, clean, and roomy canteen must be organised; and adequate facilities for recreation must be arranged for. In the briefest compass, but with convincing earnestness and sincerity, the author thus puts his successful experience at the service of employers, who can obtain further information on application to the "Welfare" Section of the Ministry of Munitions (6, Whitehall Gardens, S.W.), and we strongly urge them to delay not a moment in emulating Mr. Walton's admirable example.

I.M.E.A. Annual Meeting, 1917.—The official programme of the 22nd annual meeting of the Incorporated Municipal Electrical Association, just issued, shows that this year's meeting will be held at the Institution of Civil Engineers, Great George Street, Westminster, on June 21st and 22nd. On the former day, the presidential address of Mr. F. M. Long (Norwich) and a paper on "Individual Interests in Municipal Enterprise," by Mr. J. H. Bowden (Poplar), will occupy the morning, while in the afternoon Mr. J. A. Robertson (Salford) will read a paper on "Fuel Economy." The second day is given up to the annual general (business) meeting, to receive the annual report, elect officers, &c.

A special meeting is to be held to consider the revision of the articles of association relating to the constitution and election of the Council. The programme is subject to revision if found necessary; all communications to the Secretary, I.M.E.A., 28, Bedford Square, London, W.C.

Electric Vehicles in Germany.—Owing to the scarcity of petrol in the country, a writer in an American motor paper, who has recently returned from a visit to Germany, reports that there has lately been a great increase in the number of electric motor vehicles of the industrial type. The same writer states that, owing to the demand for lead for munition purposes, lead batteries have, in a large number of cases, been supplanted by a new type of accumulator. Describing it in non-technical language, he states that "this novel battery is of the gas type, in which water, with a slight acid percentage, is decomposed by the current on entering, is stored in cathode and anode spaces in the form of oxygen and hydrogen, being compressed therein by suitably-designed mchanism, and, when the battery is drawn upon, the gases issue from their chambers through reduction valves in proper proportions and again combine to water, freeing the amount of current absorbed in the decomposition of the liquid. The poles of this battery are faced with 'Platinmohr,' black amorphous powder of platinum, which is at once a good conductor of electricity and a good catalysing agent, being used to a great extent in the making of sulphuric acid."

Our Mineral Resources.—A new branch of the Ministry of Munitions has been established to deal with the examination and development of such mineral properties (other than coal or iron ore) in the United Kingdom as are considered likely to be of special value for the purposes of the war. The Minister of Munitions has appointed the following gentlemen to act as an Advisory Committee on the development of mineral resources:—Sir Lionel Phillips, Bt. (chairman), Mr. F. J. Allan, Mr. C. W. Fielding, Mr. R. J. Frecheville, Prof. F. W. Harbord, Mr. F. Merricks, Sir Harry Ross Skinner, Dr. A. Strahan (representing the Geological Survey), and Mr. Edgar Taylor, together with a representative to be nominated by the Board of Trade.

Prisoners of War Fund: Football Match.—An interesting event in connection with the effort being made by the Cardiff *Evening Express* to raise funds to send food to starving prisoners of war took place at Cardiff on Saturday, March 31st, when members of the electrical industry in Cardiff and Bristol did their "bit" to further this worthy object. A Local Committee under the presidency of Mr. W. A. Chamen (South Wales Power Distribution Co.), and comprising representatives from every branch of the profession and industry, issued a challenge to similar representatives of Bristol to play an Association football match at Cardiff. The challenge was enthusiastically taken up at Bristol, and a strong side was taken over to Ninian Park, under the captaincy of Mr. W. Wedlock (the Bristol City captain and English International). The "Bristol City Electricals" ran out winners by five goals to love, and 2,000 spectators witnessed the match. Sir John Courtis, J.P. (chairman of the Cardiff Tramways and Electrical Committee) kicked off, and Sergt. Chalmers, D.C.M., performed a similar function at the commencement of the second half. After the match a dinner and smoking concert was held at the Queen's Hotel, at which the president and treasurer of the Cardiff Committee (Mr. W. A. Chamen) gave some interesting details of the results of the effort up to date. He announced that £170 had been cleared so far, and he had every reason to believe that a sum well exceeding £200 would be handed over.

Legal.—Harry Longbottom, electrician, of Risca, was summoned, under the Factories Act, at Blackwood, for failing to take adequate precautions in "earthing" an electric cable at the North Risca Colliery. Mr. Horace Lyne said a man named Phillips, working a mortar mill, received an electric shock when trying to start the motor, which caused his death. The wires were not properly "earthed." Mr. A. Prosser said defendant was much pressed by work, and it was a complete oversight that the wires were not protected. Defendant was ordered to pay £5 5s. costs, there being no conviction.—*South Wales Daily News.*

Dundalk Urban District Council *v.* The Attorney-General.—Before Mr. Justice Barton, at Dublin, this matter was referred to last week. It was a proceeding brought against the Attorney-General, as representing the Crown, for a declaration that, under the Public Health Act and the Electric Lighting Acts, the Local Government Board were entitled, if they thought fit, to grant a loan to provide working capital, or working balance, to enable the electric lighting undertaking in Dundalk to be carried on, wages to be paid, and other expenses to be met, until the revenue could be collected. The Dundalk Urban District Council established an electric lighting scheme under a provisional order dated 1897, made in pursuance of the Electric Lighting Acts, and for that purpose borrowed a sum of £46,000, with the sanction of the Local Government Board. In 1914 the Council entered into a contract with the Great Northern Railway Co. to supply electricity to them for power and lighting at their works at Dundalk, at a minimum price of £1,800 a year. In order to enable them to carry out this contract, which was to commence a year after it was entered into, the Council would have to erect two Diesel engines, so as to ensure a continuous supply of current to the company. Owing to the war, it was found impossible to obtain both the engines, with the result that, instead of commencing their contract with the railway company in September, 1915, they were not able to commence until September, 1916. The Council, accordingly, lost the benefit of the large payment from the railway company. In the meantime, as the contract been had entered into, and a loan had been obtained, the Council had to pay in November, 1916, to the lenders about £1,800 as instalment of the loan and interest. Owing to this state of affairs the estimated revenue was depleted, and the Council applied to the Local Government Board for sanction to a loan of £2,000, one of the grounds being that they were entitled to borrow such sum as would provide them with working capital, or working balance in each year in order to keep them going until such time as the revenue would be collected. The Local Government Board replied that they had been advised that under the Electric Lighting Acts they had no power to sanction such a loan. The question now before the Court was whether they had such power. For the Attorney-General it was argued that it was only for permanent works, and not for working capital, that a loan could be granted.

During the argument Mr. Dickie stated that the case stated did not set out the specific point which he required to have decided—namely, whether the Local Government Board had power to sanction a borrowing within the first six months after the undertaking had commenced. In these circumstances he applied for an adjournment until next sittings, when he would deliver pleadings in an action in the ordinary way.

The adjournment was granted.—*Freeman's Journal.*

Volunteer Notes.—First London Engineer Volunteers.—Headquarters: Balderton Street, Oxford Street, W.

Orders for the Week, by Lieut.-Colonel Clay, V.D., Commanding:—

Monday, April 9th.—Headquarters Closed. Last Day of Easter Training at Esher. Parade Waterloo, opposite No. 5 Platform, 9 a.m.

Wednesday, April 11th.—Instructional Class, 6 15. Platoon Drill, Platoon No. 2

Thursday, April 12th.—Platoon Drill, Platoons, Nos. 5 and 6. Signalling Class. Ambulance Class.

Friday, April 13th.—Technical for Platoon No. 10, Regency Street. Platoon Drill, Platoon No. 9. Recruits' Drill, 6.30.

Saturday, April 14th.—N.C.O.'s Class, 2.30, under Captain Bentley and the Instructor of Musketry. Subjects: Extended Order Drill and Musketry.

Sunday, April 15th.—Orders will be posted at Headquarters.

(By order), Macleod Yearsley, *Captain and Adjutant.*

The Metric System.—At the Conference of the Association of Chambers of Commerce, last week, it was resolved, by a large majority, that the Executive Council should be requested to arrange for the introduction of a Bill into Parliament to substitute the metric system for the present system of weights and measures, and to urge the Government to pass the measure during the present session.

In the final report of the Dominions Royal Commission, to which we shall refer more fully in our next issue, the Commission states that many of the Dominions have passed resolutions in Parliament, or even permissive legislation, in favour of the decimal and metric systems, and there is clearly in the Dominions a considerable body of opinion in favour of the change. The Commission is of opinion that the termination of the war will bring "an unequalled opportunity for securing this much-needed reform," and recommends the Governments of the United Kingdom and the Oversea Dominions to co-operate in establishing throughout the Empire a uniform coinage based on the decimal system, and uniform weights and measures based on the metric system.

Institution and Lecture Notes.—Institution of Electrical Engineers.—The following have been nominated by the Council for the vacancies which will occur in the offices of president, vice-presidents, honorary treasurer, and ordinary members of Council on September 30th, 1917:—

President: Mr. C. H. Wordingham.

Vice-Presidents: Dr. A. Russell* and Mr. W. B. Woodhouse.

Honorary Treasurer: Mr. J. E. Kingsbury.*

Ordinary Members of Council (six vacancies): Messrs. L. B. Atkinson, W. A. Chamen,* J. S. Highfield, Lieut.-Colonel A. E. Le Rossignol, C.B., Sir W. Slingo,* Lieut.-Colonel H. C. Sparks, D.S.O., M.C., Messrs. A. P. Trotter, and B. Welbourn.*

* At present in office.

Appointment Vacant.—Switchboard attendant, for Lancaster (32s. 6d.). See advertisement pages to-day.

Electrical Trades Benevolent Institution.—The annual general meeting will be held at the Institution of Civil Engineers, Great George Street, Westminster, S.W., on Monday, April 16th, at 2.30 p.m., Mr. A. A. Campbell Swinton presiding.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Tynemouth T.C. has resolved to advance the salary of Mr. Charles Turnbull, electrical engineer, from £325 to £400 per annum.

The Tramways Committee of the Walthamstow U.D.C. have decided that the salary of Mr. W. Murray, the tramways manager, be increased by £25, with a further increase of the same amount at the end of 12 months.

The Lighting Committee of Islington B.C. have conveyed to Mr. A. P. MacAlister, deputy electrical engineer, their appreciation of the services rendered by him, more particularly during the past year, inasmuch as he has been frequently required to undertake full responsibility for the con-

duct of the electricity undertaking, owing to the absence through illness of Mr. Gay, the chief electrical engineer. The Committee state that Mr. MacAlister has proved himself to be a most capable engineer, and has dealt with intricate matters affecting the management of the undertaking with conspicuous ability.

The Darwen Corporation proposes to pay a war bonus of £25 per year to the tramways manager, Mr. Hosken.

Mr. T. E. Boothby, charge engineer to the Southwark undertaking, having resigned his appointment owing to ill-health, Mr. E. H. Snook, of Southampton, has been appointed to fill the position temporarily.

Mr. Thos. Roles, the city electrical engineer, Bradford, is recommended for an increase of £100, making his salary £900 per annum; Mr. J. H. Shaw, the deputy engineer, is recommended for an advance of £100, making a total of £450; Mr. J. Fairburn, electrical works superintendent, advance £50, making £350; and Mr. C. F. Allsopp, electrical department commercial assistant, advance £50 (£20 war bonus cancelled), making £300.

General.—Congratulations to Mr. and Mrs. W. Llewellyn Preece on the occasion of their silver wedding.

Mr. W. G. T. Goodman, general manager of the Adelaide Municipal Tramways Trust, who intends to visit Great Britain, Canada, and the United States, has been appointed an honorary commissioner by the Deputy Governor (Hon. G. J. R. Murray) to inquire into and report upon the following questions:—Electrification of railways, mechanical handling of coal, electric power in its relation to the development of industries, equipment and management of engineering workshops, and the briquetting of lignite coal.—*Commonwealth Engineer.*

Mr. W. C. Chappell, the new assistant engineer in the State hydro-electric department, Tasmania, has taken up his duties at Hobart.

Mr. Herbert Willett, who has been in the service of the Edison Swan Co. for the past 25 years, has joined the Colours.

At Preston Police Court, the Mayor presented Mr. Whitehead, an employé of Messrs. Dick, Kerr & Co., with the honorary testimonial and vellum certificate of the Royal Humane Society for gallantry in saving life.

The following appointments to the permanent Royal Australian Naval Radio Service were announced in January:—To be Radio Commander: Engineer Lieutenant Frank Gillespie Creswell, R.A.N. To be Radio Lieutenants: Arthur Frederick Newman, George James Weston.

The Highways Committee of the L.C.C. recommends that Mr. G. H. Hume be appointed chairman of the Committee, and Mr. A. H. Scott vice-chairman.

Captain A. R. Owen, tramways and marine claims superintendent in the L.C.C. tramways department, who has reached the age of 65, has been retired from the service.

Mr. C. Jones, A.M.I.E.E., of Cannock Chase Co., Ltd., and West Cannock Colliery Co., who has been elected M.I.E.E., is nominated as president of the Warwickshire and South Staffordshire Branch of the Association of Mining Electrical Engineers for the 1917/18 session.

Roll of Honour.—Lieutenant F. Raven, R.E., who has died of wounds, was a son of Sir Vincent Raven, chief mechanical engineer of the N.E. Railway.

Lieutenant E. Douglas Coe, R.G.A., has been wounded in action. He has acted as captain since he went to the Front, and was engaged in the electricity department of Blackburn Corporation prior to the war.

Gunner E. G. Crossley, R.F.A., reported in hospital suffering from septic poisoning in the legs, was formerly at the Bradford Corporation electricity works.

Second-Lieutenant H. W. Hutchinson, who was killed on March 13th, aged 19, was the youngest son of Sir Sydney Hutchinson, late Director-General of Telegraphs in India.

Obituary.—Mr. Arthur Brooker.—The unexpected death of Mr. Arthur Brooker, in the prime of life, in the very acme of his vigour, and when one and all anticipated for him a ripe old age after a life of strenuous, fruitful labour, has come as a great shock to his very wide circle of friends, but more especially to those who were associated with him in his earlier days. He joined the Telegraph Department of the Post Office Service in May, 1878, and at the very commencement of his career gave strong indications of a distinct personality which was destined to bring him prominently before his fellows. He came of a long-lived stock—both his parents exceeded the allotted span—he was well to the fore in athletic sports and competitions, he lived a clean, wholesome life; and these facts, which were generally known, made all the more painful his untimely death at the comparatively early age of 53. The Telegraphists' School of Science, which was established at the Central Telegraph Office in 1876 as a pioneer in the cultivation of a sound training in the fundamentals and technical applications of electrical science, soon claimed his attention, and he speedily became an ardent student, securing many successes in physics and mathematics, and in several technical subjects. Among his successes, he gained a bronze medal and £3 prize in the City and Guilds examination in telegraphy, and the first prize in the honours grade of electrical instrument making, consisting of a bronze medal and £5. In 1889 he became an instructor in the School in mathematics and laboratory practice, and the following year he was made chief instructor. He was also on the staff of the People's Palace and the Currie School of Engineering as instructor in electrical engineering. During the remaining years of the existence of the School, which was closed in 1898, he was a most loyal supporter of the principal, an enthusiastic teacher, and a personal friend of the students. His methods were marked by a decided originality which proved eminently successful, and which helped materially in the phenomenal successes attained by the students during their training, but more especially in after life, when those students became the scientific backbone of what is universally regarded as the most advanced and most up-to-date telegraph administration in the world. His scientific attainments procured for him rapid promotion in the Post Office service. He had three promotions in less than two years, and was largely responsible for the development of the present highly specialised testing branch, where the enormous supplies of apparatus and material are tested and proved on scientific bases which are generally acknowledged by manufacturers as affording the best and fairest standards, and have been adopted by very many foreign and colonial administrations. It was, however, his association in the production of Slingo and Brooker's "Electrical Engineering" in 1890 which brought his name more prominently before the public. The genesis of the book dates from a meeting of the would-be authors in the laboratory of the Telegraphists' School of Science after school hours, that is to say, at 10.30 p.m., on February 28th, 1889, when the decision to write the book was arrived at, its general scope and aim were determined, its contents page drawn up, and several chapters divided between the two authors. The zeal with which the two men worked can to some extent be realised when it is stated that the book was on sale at the end of February in the following year, and reviews began to appear on the 7th of the following month. Within a fortnight of its publication (and the first edition consisted of 2,000 copies) the publishers notified that a second edition was in preparation. The book was the first of its kind; it broke quite new ground, it was written from beginning to end to suit the requirements and capacity of a particular individual student, and he must have been fairly typical, for some 40,000 copies of the book have been disposed of, and its circulation has spread to every part of the world where the Anglo-Saxon tongue is understood. The sale was phenomenal, but perhaps the class who took to it most enthusiastically were the marine engineers. Every vessel as it was equipped with the electric light was also provided with its "Slingo and Brooker." The general style of the book, its language, the analytical diagrams, and the simple illustrative calculations were all points which appealed to the practical engineer, cut adrift as he was from every chance of appeal or assistance. Many a time has Brooker, when in quiet converse with old-time friends, referred to the meetings for proof-reading and for discussing debateable points of fact, theory, and phraseology, for these meetings often began at 11 p.m., after a full day's work in the office, the laboratory, and the class-room. Severe as the work was, the reward was great in comparison, for a firm position in engineering had been established, innumerable good and sincere friendships had been made, and an *entrée* gained into any assembly of men who valued hard work and good fellowship. After the publication of the book the authors entered into journalism, and contributed largely to the pages of the Electrical Review, one of the most important contributions being a series of articles on "Storms and Telegrams," which appeared in the beginning of 1891, and which were translated and reproduced in the *Journal Télégraphique of Berne*. These articles brought the authors into an interesting tussle with the late Sir W. H. Preece, but they had their effect, and resulted in more substantial methods of construction and a better system of maintenance. In 1898 Arthur Brooker severed his connection with the Post Office, and became works manager of the Peel Works of the General Electric Co., Ltd., where he spent seven years in organising the factory and devoting himself to the wholesale manufacture of telegraph and telephone apparatus, of which he was able to bring down the cost very materially, and thereby to extend the operations of the firm. In 1906 he joined the British Insulated Co. as assistant to Mr. Dane Sinclair, and on the formation of the Automatic Telephone Manufacturing Co. in 1912 he became its general manager, a position he retained until shortly before his untimely death as the result of a nervous breakdown. During these years he gathered round him a staff of truly loyal assistants, who soon recognised his many good qualities, his readiness to take responsibility, and to give them the benefit of his long and varied experience, and his sympathy with them in their difficulties and troubles. Since the commencement of the war he had devoted the energies of his company to meeting the requirements of the Munitions Department, and his organising abilities in this direction were so outstanding, and his output of munitions so considerable and so good in quality, that he had already taken up an important position under the Ministry when his first and last illness overtook him. He leaves a widow who, since his marriage in 1905, has been a real helpmate and companion, to mourn his loss.

Mrs. J. S. Raworth and family desire to express their thanks to those who have so kindly sympathised with them in their great bereavement. The number of letters received

is so great that they cannot at the moment be acknowledged individually; it is hoped that they will be in the future.

Mr. W. Baily.—The *Times* records the death of Mr. Walter Baily, for many years secretary and vice-president of the Physical Society, and inventor of two-phase electric motors, at the age of 80 years.

CITY NOTES.

City of London Electric Lighting Co., Ltd.

Mr. J. B. Braithwaite, presiding at the annual meeting, said that they had reduced the loan from the bankers from £66,000 to £34,000 by the end of 1916, and it now stood at nothing. The gross revenue had increased by £21,116, due to the increase in price of which they had had nine months' benefit. This year they would have it for the whole twelve months, which should enable them to maintain their revenue, and possibly show a further increase. The increase in cost of generation was £20,817. Rents, rates, taxes, management expenses, and special charges increased by £38,000. Including the balance brought forward, the total available revenue showed a decrease of £22,284. They had reduced the allocation to depreciation from £50,000 to £40,000 this year, as they had debited £12,181 for war bonus to employés and allowances to employés on service straightaway to revenue instead of carrying those items to a suspense account for writing off over a period of years. In 1915 coal cost £49,858, but in 1916 it was £18,428 more, which was almost exactly the amount of the reduced net revenue. This increase in coal cost was chiefly due to the exceptional freights on sea-borne coal. Their works were put on the water to secure cheap coal, but they were now temporarily suffering from the fact that at present railway-borne coal was cheaper than sea-borne coal, because railway freights had not increased to the same extent as sea freights. When they got back to normal times they would again reap the advantage of water-borne coal. Sir Albert Stanley had stated that they would have to burn less coal. He (the speaker) knew from past experience that it was a popular idea that the electric supply authorities of the country were the great offenders in that respect. As a matter of fact, all electric supply companies were great economisers of coal. To illustrate this he gave figures drawn up on a very conservative basis which might easily have been made to appear more favourable to the electric supply industry than they did. During 1916 there were used in electric supply, not including electric traction or electric railways, 2,000 million units. Taking a very low rate of production, say, only 500 units per ton of coal (whereas, as a matter of fact, in power houses like their own the figure was very much nearer 1,000 units than 500), that consumed 4,000,000 tons of coal during the year. Now, if there had been no electric supply the same needs would have been supplied with less convenience, less value, and less efficiency, and would have required at least 9,000,000 tons to do it. The saving had, therefore, been by the use of electric, instead of other forms of energy, 5,000,000 tons of coal, so that in seeking to reduce the consumption of coal by electric supply companies the authorities would be, so to speak, "killing the goose that lays the golden eggs." They would be hitting the very people who were economising coal. Supposing the authorities said that they would restrict the supply of light by electric companies, with a view to economising coal, the effect would be either that they would increase the consumption of coal or that the people would have to go without light altogether, which was hardly possible indoors. This was very much more true in respect of electric power. In the case of this company, 55 per cent. of its supply was used for power and heating and 45 per cent. for lighting. In regard to the future, they were extremely anxious not to increase the price further if it was possible to avoid it. Output had increased about 13 per cent. this quarter.

Brompton and Kensington Electricity Supply Co., Ltd.

At the annual meeting the Chairman said that the year had been one of exceptional difficulty, and the result had obliged them to recommend a reduction in the annual dividend which had been regularly distributed for the last 13 years. This had occurred in the year in which the Summer Time Act first came into operation. Whatever might be the effect of daylight-saving upon society at large—and he was inclined to regard it as decidedly beneficial—there could be no doubt that to the purveyor of artificial illumination it was an unmitigated evil. It amounted, in fact, to an impairment of the statutory basis of the electric lighting industry, for which it was very difficult to find adequate reparation in an increase of price. But the diminution in output from that cause was by no means the sole cause of the loss of profit. The war had compelled restrictions and economies in the consumption of light, and it had increased the cost of its production in consequence of a phenomenal rise in the price of coal, and a general increase in working charges. It had reduced income and increased expenditure. In spite of a steady growth in lamps connected, and of a 10 per cent. increase in price, and in spite also of the development of electric cooking, which now amounted to over 10 per cent. of their total output, the falling-off in receipts was about £600. They burned less coal, but paid much more for the reduced quantity, and the account benefited by an allowance of £1,250 which they were able to obtain for faulty delivery under contracts in the previous year. Thus the increased coal cost amounted to £500, and it would have been less but for a delay in the delivery of the new 1,500-kw. turbo-alternator owing to the difficult manufacturing conditions prevailing. The new generating plant was now working most satisfactorily, and was largely reducing their coal consumption. This economy would result in a considerable saving. The coal position continued to be an anxious one, but they had a larger stock than at this time last year. The burden of administration devolving upon the reduced staff had been borne with cheerfulness and devotion. Although, on account of the war, the progress of the Accessories Co. had been slower than anticipated, the manufacturing side of the business especially having been curtailed owing to the difficulty in obtaining material and the prohibition of imports, the undertaking was to-day working without loss, and the prospect, on a return to normal conditions, was satisfactory.

Charing Cross, West End and City Electricity Supply Co., Ltd.

Mr. W. F. Fladgate, addressing the recent annual meeting, first referred to the death of Mr. R. Chadwick, who had been a director for 22 years. In these times of extreme difficulty, it had taxed the ingenuity and the work of all the members of the staff, and particularly of the engineer-in-chief, Mr. Kingston, and of the secretary, Mr. Stanesby; he could not speak too highly of their services, and of those of the staff under their control. Without careful co-ordinated work between the two important branches of the company—the secretarial and the engineering—they could not possibly have arrived at the satisfactory position shown in the accounts. The net revenue in the West End had increased by £2,700, and the total available net revenue was £71,640. That was arrived at after spending £10,000 on repairs and maintenance of the stations and mains in the West End during the year. In regard to the expenditure of £4,900 on capital account, that was a very productive item, as it was on the erection of buildings in Short's Gardens which were already let at remunerative rentals. In the case of the City undertaking, the results were equally satisfactory, the net revenue having increased by £1,788. In addition to carrying forward £18,000, and transferring a large sum to reserve, they had spent £15,000 in keeping the plant and mains in an efficient state of repair. Comment was usually made as to there being no depreciation fund in connection with the City undertaking. It was, perhaps, better therefore to explain that, having regard to the form of the Provisional Order, they were advised that no depreciation fund was necessary, and as they did not divide their profits, but simply paid the dividend on the preference shares, and carried the rest to general reserve, it seemed immaterial whether there was a depreciation fund or not. The balance of general reserve was £104,562. In regard to the general state of the company, they did not feel any great nervousness for the future. They quite appreciated that the task before them and the staff was still a heavy one, but they honestly believed that there would not be any danger of the company doing otherwise than passing safely through this very trying period and emerging from it stronger than ever. Their position had never been stronger than it was at the present moment. Under war conditions nothing in the way of an amalgamation or a working together of the companies was possible. They had, however, through the committee of the companies, of which he was chairman, been able to secure an increase in the excess profits standard from 6½ to 7½ per cent. The company was not materially interested, as he was afraid there would be no excess profits during war-time, but it was a matter of principle. It appeared to them unfair that the taxation of a company which had only a provisional order for a limited period should be put in the same position as a company with a perpetual existence. The application was made practically on the part of the whole of the London companies. He hoped that all those companies would see their way to work together in the future.

Coalite, Ltd.

Presiding at the recent meeting, in London, Mr. H. Willmott said that there could not be any marked change in the finances of the company until the works at Barnsley were in full operation and proved the process to have the value that they attached to it. They hoped the plant would start working soon; the delay in its completion had been due chiefly to labour difficulties and war conditions. Now that every civilised nation had become alive to the vital importance, not only of conserving its coal energy, but of providing cheap power for every form of industrial enterprise, as well as to the enormous value attaching to the recovery of the many valuable by-products from coal distillation, it was manifest that low temperature carbonisation must progress by leaps and bounds. They had the priceless advantage of being the first in the field to prove both the practicability and economical advantages attaching to low temperature distillation as carried out by this process. The Government was carefully watching the development, and a very important committee had been appointed by the Board of Trade to deal with the economical supply of electric power for all classes of consumers in the United Kingdom. They were perfectly satis-

fied that their process would give the country cheap electric power, which was the greatest economical factor we had to face from now onwards, and, in addition, all the many by-products obtained from low temperature distillation, such as motor spirit and the heavier oils, that the country was importing at the present time at an enormous cost, in addition to which there were the other valuable by-products, for which there was practically an unlimited demand. The British Coalite Co., with which they were naturally closely allied in interest, appeared to be on the eve of reaping some advantage from the seed it had plentifully sown. That company, which owned the British rights for the processes in respect of which the company controlled the foreign patents, was arranging to grant a licence for the use of the process for the United Kingdom to a development company which was about to be formed, with which very powerful interests were connected, with an issue capital of a least £50,000, part of a nominal capital of £100,000, on terms that should be mutually satisfactory.

German Electrical Companies.

The Aluminium und Magnesium Fabrik of Hemelingen, Bremen, records net profits of £19,000 for 1916, as compared with £16,000 in 1915. The dividend recommended is at the rate of 18 per cent., as compared with 15 per cent. in the preciding year.

The Deutsche Kabelwerke A.G., of Berlin-Lichtenberg, realised gross profits amounting to £67,000 in 1916, as against £74,000 in the previous year, the works having been well occupied during the year. As the plant has already been entirely written off the books to the nominal sum of 1s., the only provision made for depreciation last year is £1,500 for buildings. The net profits are £31,000, as compared with £35,000, and the dividend is at the rate of 8 per cent., this contrasting with 6 per cent. in 1915.

The directors of the *Kabelwerk Duisburg A.G.* report gross profits on manufacturing of £119,000 in 1916, as compared with £114,000 in the preceding year. After making various appropriations and setting aside £5,400 for depreciation, as against £5,600 in 1915, the accounts show net profits of £74,000, as contrasted with £81,000. It is proposed to pay a dividend of 16 per cent. and a bonus of 9 per cent., making 25 per cent., as against 18 and 12 per cent. respectively in 1915, or 30 per cent. together.

The Elektro-Osmose Gesellschaft, of Berlin, which was formed in 1913, reports that notwithstanding difficulties in working, it was possible for the company to carry out much scientific work and many experiments in 1915-16, and to bring them in part to a final conclusion. The Kaolin Elektro-Osmose Co. made further progress, whilst the plant of the Westerwald Elektro-Osmose Ton Gewerkschaft is shortly to be put into operation. The accounts of the Berlin company show a small profit for the year, this comparing with a loss of £14,000 in 1914-15.

The Brandenburg Carbid und Elektrizitats Werke, of Berlin, report that the production of carbide in the year ended on March 31st, 1916, was less than in the preceding twelve months, owing to the unfavourable water conditions, particularly in Norway. Nevertheless, good results were obtained in Germany as a consequence of the higher sale prices. A further large increase took place in the supply of electrical energy despite the difficulties of extending the overhead network on account of the war. The net profits amount to £14,000, as compared with £15,000 in 1914-15, and a dividend at the rate of 7 per cent. has been declared, as in the previous year.

The Grosse Berliner Strassenbahn A.G. intimates that, despite the considerable augmentation in the car mileage run in 1916, and the expansion in the receipts by nearly £300,000, the company is compelled to reduce the rate of dividend from 6 per cent. in 1915 to 4 per cent. for last year owing to the growth in the cost of materials and wages, and the excessive provision necessary for depreciation due to the extraordinary wear and tear of the tracks and cars. A deficit has only been avoided by the suspension of legal restrictions so as to permit of the overcrowding of cars, the greater use of trailers, and the stoppage of working in the case of unprofitable lines.

The Ges. fur Elektrische Hoch und Untergrund Bahnen, of Berlin, announces a dividend of 3 per cent. for 1916, as compared with 4 per cent. in the previous year. It has been necessary partly to draw upon the balance brought forward from 1915 in order to pay the dividend owing to higher working expenses, and notwithstanding the fact that the traffic receipts on this underground and high-level railway increased from £458,000 in 1915 to £526,000 last year. The traffic has further increased in the present year, but this has not equalised the further rise in wages and the prices of raw materials, and unless the fares are advanced a further decline in the net revenue is held in prospect for the current year.

The Sachsenwerk, Licht und Kraft A.G., of Niedersedlitz, Dresden (the former Kummer concern), reports an increase in the turnover in 1916 to £2,000,000 as a result of extensions of the works and the greater degree of activity. After allocating £72,000 to depreciation, as against £24,000 in 1915, the accounts exhibit net profits of £53,000, as compared with £47,000, and the directors recommend a dividend of 20 per cent. on the share capital of £225,000, as contrasted with 18 per cent. in 1915. It is now proposed to increase the share capital by £150,000, and the board suggest that part of this sum should be provided by the acceptance by shareholders of the dividend in the form of new shares.

The directors of the *Norddeutsche Kabel Werke A.G., of Neu-Kolln, Berlin*, which was formed in 1914 with the co-operation of the Mix & Genest Co., the Town Council of Neu-Kolln, and the Mansfeld Copper Co., state that the working results in the year ended on September 30th, 1916, were satisfactory, having regard to the disturbance caused by the removal of the works from Schoneberg to Neu-Kolln, which was completed at the beginning of last summer. As net profits, the accounts show the sum of £11,000, as contrasted with £6,500 in 1914-15, and a dividend at the rate of 10 per cent. has been declared on share capital of £52,000, and 2½ per cent. on £22,000, as against 8 per cent. It is proposed to increase the share capital by £50,000, so as to be able to execute larger Government orders.

Llanelly and District Electric Lighting & Traction Co., Ltd.—Mr. A. R. Holland, at the annual meeting, said there was a more satisfactory showing than for 1915, owing to an all-round improvement in electricity supply and tramway sections. Coal cost approximately 60 per cent. more than in pre-war times, and nearly 30 per cent. more than in 1915. Labour conditions were extremely difficult. Women conductors had been employed on the cars with some success, and the directors were watching the labour question very carefully. New power consumers were being secured at satisfactory rates under long-term contracts, which showed that the business was of a permanent nature. Extensions to the power station plant would be in service toward the end of April, and this should have a favourable effect on the current year's results.

Salisbury Electric Light & Supply Co., Ltd.—Mr. C. J. Woodrow, addressing the annual meeting, referred to the difficulties of the year. They looked forward to a great improvement after the war. They had reluctantly come to the conclusion that the price of current must be raised, but the increased price did not cover the cost of production. Mr. Gripper said that they sold exactly the same number of units last year as in 1913, and they received £9,630, against £9,040 in 1913. Their expenses, however, increased by £1,500. Though the income was larger by nearly £600, the profit was nearly £900 less; that was why they must increase the charge, but only for the period of the war, he thought.

Dublin and Lucan Electric Railway Co.—The company held its annual meeting on March 29th. The traffic receipts during 1916 increased by £104, and the expenditure by £482 owing to enhanced price of coal and other materials. Coal, which averaged £752 for twelve years prior to the war, rose to £2,572 for 1916. After paying debenture interest, £313 is to be carried forward, the payment of the cum. pref. dividend being postponed for the present. The mileage had been somewhat reduced, and that had to some extent reduced the expenses without reducing the receipts. Passenger fares and goods rates had been slightly increased. It was observed that the company's line was the only one in Dublin that maintained a continuous service during Easter week last year.

Slough and Datchet Electric Supply Co., Ltd.—During 1916 the connections increased by 3,275 lamp equivalents (30 watts). The units sold increased from 1,070,927 to 1,367,557, and the revenue from £9,625 to £12,012. The increase of £2,387 in revenue is due to the large sale of current for power, and to the bulk supply to the Windsor Co. Receipts from lighting supply were reduced by £600. The increased revenue has been more than neutralised by the high prices of coal and fuel oil, &c. The net profit available is £3,487, out of which £1,500 is put to depreciation and reserve, 3 per cent., less tax, is paid on the shares, and £192 is to be carried forward. Mr. Prior resigned the chairmanship, and Mr. Jackaman has taken his place.

Windsor Electrical Installation Co., Ltd.—The profit for 1916, including £779 brought forward, was £4,516. After paying debenture and other interest £560, preference dividend £912, putting £1,500 to depreciation, renewal and reserve, paying £250 directors' fees, and 2 per cent., less tax, on the ordinary shares, £519 is to be carried forward. Lighting restrictions and the Summer Time Act reduced receipts from the more remunerative class of consumer. Owing to a large increase, however, in the sale of cheap power units, the net receipts show only a small reduction in revenue. Cost of fuel and other materials considerably increased the working expenses and seriously affected the profit.

Urban Electric Supply Co., Ltd.—The gross profit for 1916 was £64,983, as against £68,513 for 1915. After deducting expenses, the balance is £61,772. Interest and debenture stock redemption absorb £43,748; £10,000 to reserve for depreciation; 2½ per cent. is to be paid on the preference shares (£6,250), and £1,774 carried forward. The directors regret that under existing conditions they do not feel justified in paying the preference dividend in full. We shall publish the usual table of results of the various undertakings next week.

Australia: Electric Light & Power Supply Corpn., Ltd.—The directors have been authorised to issue 60,000 £1 shares.

Commonwealth Edison Co.—The accounts for 1916 show a total income of $6,498,806, as compared with $6,519,462, and after providing for dividends amounting to 8 per cent., the same as for each of the two preceding years, there remained a surplus of $732,301, increasing the total surplus brought forward to $5,175,264.—*Financial Times.*

Russia.—The Industrial and Electrical Constructions Co., Ltd., Petrograd, began business in January.

The Tabreer Electrical Stations "Otes" Co. is being formed; capital, 2,000,000 roubles.

The Russo-French Electro-Mechanical Co., Petrograd, began operations in January.

Tramways & Light Railways Estates Co., Ltd.—The total revenue for the year was £804. The surplus is £619, plus £558 brought forward. A dividend of 3 per cent. is to be paid, and £626 carried forward.

Vickers, Ltd.—Final dividend for 1916, 1s. 6d. per share (free of tax) on the ordinary, making 12½ per cent. for the year.

S. Smith & Sons (Motor Accessories), Ltd.—Interim dividend, 9d. per share, free of tax, for half-year ended January 31st.

Anglo-American Telegraph Co., Ltd.—Interim dividend for the March quarter, 15s. per cent. on the ordinary stock and £1 10s. per cent. on the preferred stock, less income tax.

STOCKS AND SHARES.

SATURDAY AFTERNOON.

WAR Stock naturally monopolises most of the attention in the investment markets for the time being The quotation, after giving way, recovered to within ⅛ of its issue price; and the effect upon other high-class securities may now be written off as virtually nil. People who sold good stocks in order to invest their money in the War Loan are beginning to ask whether they were not a little hasty, and the demand now runs on debenture and preference shares that were pressed for sale what time the War Loan lists were open. The tone throughout the market is good, the excellent news from the Western Front and from Syria being a stimulus to investment of the large amounts of money which are available—more particularly in the Northern provinces.

Home Railway Stocks are slightly disturbed by the announcement of the Board of Trade that it is desirable there should be no extra travelling at Easter, and that no relaxation of the higher fares must be expected during the summer months. Why this should have affected prices it is difficult to say, because it makes little difference to the companies themselves, so far as dividends are concerned. Underground Electric incomes weakened because of the withdrawal of some of the 'bus services, and the probability of yet other routes being re-arranged in consequence of the necessity for conserving petrol. National Steam Cars, by the way, have improved for this reason.

The market for electricity supply shares is very firm, and buyers are beginning to put in an appearance, only to find that holders are anything but willing to sell at the current levels. This is as good evidence as could be desired of the faith which investors have in the market, because there are several influences at work—*e.g.*, the Daylight Saving, the calling-up of more men, the difficulties connected with coal—which are scarcely bull points for the industry at present. They are purely temporary influences, of course, though it may be assumed that Daylight Saving will continue long after the war is over. The earnings of the various supply companies are greatly helped by the demand for power; and this should prove the mainstay of profits while the lighting receipts suffer from war conditions.

In view of the difficulty that there is of obtaining good stock, we hope it may be of use to set out a few investments which are actually on offer in the market at the moment. Securities are so quickly snapped up nowadays that before these lines appear some of the instances noted may have been taken; but as we write, the following can be obtained:—

Stock or share.	Price.	Yield.	Dividends payable.
Bournemouth & Poole 2nd Preference	9⅛	£6 5 0	March, Sept.
British Electric Traction 4½ % 2nd Debenture ...	70	6 8 6	May, Nov.
British Westinghouse 4 % Debenture	68½	5 16 9	Jan., July.
Chelsea 6 % Preference ...	4⅞	6 3 0	Jan., July.
Electric Construction 4 % 1st Debenture	68	5 17 9	Jan., July.
London & Suburban Traction 4½ % 1st Debenture ...	65½	6 17 6	Jan., July.
Metropolitan Electric Trams 5 % Debenture	81	6 3 6	Jan., July.
Winnipeg Electric 4½ % Debenture	71	6 7 0	April, Oct.

We have confined ourselves to fixed-interest stocks and shares, but in the Ordinary list there are attractive purchases, though it is more difficult to set out a selection of these for the simple reason that there are comparatively few actually on offer.

The price movements this week in our tables are trifling. With Easter so near at hand, the ordinary reason for quietude would be to ascribe it to reluctance on the part of the buyer to be bothered with stocks and shares on the eve of the holiday. This, however, can scarcely be advanced at the present time as acting upon the stock markets, for volunteering and allotment-digging will take the place of seaside holidays this year, and these call for less interruption than the latter do.

However, the fact remains that business is quiet, except in the rubber share market. The activity here continues apace. Prices gave way on a shrinkage of orders, but as soon as the demand was resumed, they started to recover. Although not so buoyant as it was a fortnight ago, there is plenty of resiliency in the market. Tin shares are mostly better, thanks to the big rise in the price of the metal; and the recent improvement in copper shares is yet more than maintained.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price Mar. 31, 1917.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	9	6⅜	—	£7 11 0
Charing Cross Ordinary	5	5	8½ xd	—	7 13 10
do. do. 4½ Pref.	4½	4½	5	—	7 1 9
Chelsea	4	3	3	—	6 18 4
City of London	8	8	11⅜ xd	+ ⅜	7 0 8
do. do. 6 per cent. Pref.	6	6	9½ xd	—	6 8 1
County of London	7	7	10½	— ½	6 18 8
do. 6 per cent. Pref.	6	6	9⅛	+	6 8 1
Kensington Ordinary	7	10	5⅛	—	5 11 7
London Electric	3	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	3⅜	—	5 6 8
Metropolitan	3	3	2⅞	—	6 9 9
do. 4½ per cent. Pref.	4½	4½	3½	—	7 4 0
St. James' and Pall Mall	8	8	6⅛	—	6 10 8
South London	5	5	2½ xd	—	7 5 6
South Metropolitan Pref.	7	7	9 /-	—	*8 13 4
Westminster Ordinary	7	7	5⅜	—	6 5 9
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	94	—	6 7 8
do. Def.	33,6	1½	22	—	6 16 4
Chile Telephone	8	8	6⅞	—	5 15 3
Cuba Sub. Ord.	5	5	7½	—	6 13 4
Eastern Extension	8	8	18½	—	*8 16 4
Eastern Tel. Ord.	8	8	1£9	—	*8 15 1
Globe Tel. and T. Ord.	7	7	11⅜	+ ⅛	*6 0 5
do. Pref.	6	6	9⅛	—	6 6 4
Great Northern Tel.	22	21	3⅝	—	6 1 0
Indo-European	13	13	46½	—	6 19 9
Marconi	10	10	2⅛	—	3 11 0
New York Tel. 4½	4½	4½	1 1	—	4 9 0
Oriental Telephone Ord.	10	10	2½	—	4 14 1
United R. Plate Tel.	8	8	6⅝	—	*6 2 0
West India and Pan.	6d.	6d.	¾	—	2 12 6
Western Telegraph	8	8	13½ xd	+ ⅛	*5 16 4
HOME RAILS.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	24½	+ ½	4 3 0
do. District	Nil	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	Nil	1½	—	Nil
do. do. "A"	Nil	Nil	5⅜	—	Nil
do. do. Income	6	5	78½	— ½	*6 7 0
FOREIGN TRAMS, &c.					
	Dividend 1914.	Dividend 1915.			
Adelaide Sup. 6 per cent. Pref.	6	6	5	+ 7/16	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	2⅞	—	9 11 4
do. 2nd Pref.	5½	5½	2⅝	—	—
do. 5 Deb.	5	5	64½	—	7 15 0
Brazil Tractions	4	4	46⅜	—	8 12 0
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Ptce.	5	5	62	—	8 1 4
do. do. Preferred	—	Nil	45	—1	Nil
do. do. Deferred	—	Nil	30½	—	Nil
do. do. Deb.	4½	4½	62½	—	6 16 0
Mexico Trams 5 per cent. Bonds	—	Nil	27½	—	Nil
do. 6 per cent. Bonds	—	Nil	26	—	Nil
Mexican Light Common	Nil	Nil	7⅜	—	Nil
do. Pref.	Nil	Nil	14⅜	—	Nil
do. 1st Bonds	Nil	Nil	27½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	14	15	21⅝	+ 3/16	5 6 0
British Aluminium Ord.	5	7	28 6	—	7 0 4
British Insulated Ord.	15	17½	192	—	6 17 3
British Westinghouse Pref.	7½	7½	2½ xd	—	5 0 0
Callenders	15	20	12⅝	—	7 18 5
do. 5 Pref.	5	5	4	—	5 5 0
Castner-Kellner	20	22	8 5/16	—	6 13 0
Edison & Swan, £3 paid	Nil	—	7/16	—	Nil
do. do. fully paid	Nil	—	1⅛	—	Nil
do. do. 4 per cent. Deb.	4	4	66	—	6 1 3
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	94	—	6 6 4
do. Ord.	10	10	14½	—	6 18 0
Henley	20	25	15½	—	8 1 3
do. 4½ Pref.	4½	4½	4	—	5 13 6
India-Rubber	10	10	11⅞	—	*8 8 4
Telegraph Con	20	20	26	—	*6 13 4

* Dividends paid free of income-tax.

Summer Time.—Summer time is to be re-introduced on Sunday next, April 8th. The clock will be put forward one hour at 2 a.m. Normal time will be resumed on the morning of Monday, September 17th. In Germany a similar change will be made on April 15th.

SOME NOTES ON BONDING AND EARTHING THE LEAD SHEATHING OF UNDERGROUND CABLES, WITH SPECIAL REFERENCE TO SOLID SYSTEMS.

By G. W. S.

The practice of bonding the lead sheathing of underground cables across joint boxes is now commonly adopted, and the need for doing this is largely recognised. The days when it was considered sufficient that the lead of a ·75 concentric cable should be made continuous by a bond consisting of a single strand of 18 S.W.G. copper wire tacked on to the lead of the cable with hard solder are now over, it having been found by bitter experience that such bonding, so far from being of any service, is a positive danger to the cable system. It might, indeed, be said that the bonding and earthing of cable leads has become an article of faith with many mains engineers, inasmuch as it is seldom considered what is the reason for bonding and earthing, whether there is any necessary connection between the two, and whether these practices should be universally applied.

The reason or object of bonding electric cables may be briefly stated to be to enable all parts of the lead sheathing of a cable system to be maintained at approximately the same potential, and in good condition, notwithstanding that a heavy fault current may be flowing. If the cable leads are earthed in addition, such potential will be approximately that of earth. To fulfil this condition, obviously bonds of ample cross-section are necessary, and, more important still, the connection of the bond to the lead of the cable must be efficiently made. Many a bond of ample size has failed on the passage of a considerable fault current, through being simply tacked on to the lead, the joint of bond to lead having become heated and the bond isolated, with, of course, serious damage to the lead, and the creation of another fault, maturing either at the time or some months later. Bonds should, therefore, be secured to the lead of a cable by being made to embrace the whole circumference, the joint then being plumbed, and an ample amount of metal being used.

Earthing the lead of cables that are armoured and laid direct in the ground, and of those drawn into conduits, can be well understood. In these cases the lead is uninsulated, and it is essential, in order to avoid stray currents getting on to or leaving the lead, to maintain the same at earth potential. In the case of cables laid on the solid system, the reason is not so apparent. The whole object of the care taken in laying cables on the solid system seems to be to insulate the lead efficiently. The numerous precautions requisite to be taken in filling the channels, and the use of asphalt or stoneware bridges that now characterises the best practice, all suggest the question why, having been at such pains efficiently to insulate the lead of the cables, we should be so careful to earth it.

The earthing of the lead of a solid system of cables occurs at each service, or other buried box, if, as is the usual custom, these boxes are bonded to lead, and through the lead of the feeders to the earth plate at the works. It is readily seen that, by insulating the lead of the cable from the various boxes, and by removing the earth connection to the lead of the feeders at the works, the metallic sheathing of the whole of the cables of a well-laid solid system would be insulated from earth.

The question immediately arises as to what degree of insulation could readily be maintained. By the use of boxes with the compound pocket type of gland, it should not be difficult to design an insulating bush of suitable shape and material to maintain good insulation between the lead of the cable and the iron of the box. To make a sound job, and to obtain additional security, 6 in. of the channel on each side of the box could be filled with box compound instead of pitch. It would, of course, be inadmissible to connect the lead of any branch cable with the lead of the main, unless the branch were laid solid. This would present no difficulty where iron service boxes were used. If, however, service joints of three or four-core distributors were covered by lead T-sleeves it would be quite possible, by removing a narrow strip of lead from the branch cable near the sleeve, to maintain the insulation of the distributor lead. The break of the lead of the service cable would be covered by an insulating sealing fitting, such as is used for isolating the lead of traction feeders into short lengths. This fitting, being pitched in with the T-sleeve, would make quite a sound job. The lead of the armoured cable service would, of course, have to be earthed, and this would be done by bonding it to the service box, and also, if thought desirable, to the water main inside the building. It would not be possible to maintain such effective insulation of the lead of the distributor if the boxes used were of the brass gland type. Although the brass gland could be insulated from the box, to do so would really sacrifice all the advantages of this type. Experience has proved however that, given a careful jointer, a box of the compound pocket gland type will make as sound a job as one of the brass gland type, without calling for so high a degree of skill, the plumbing of the brass glands, especially when these are large, being an operation requiring a first-rate plumber.

With a system of cables arranged as described above, breakdown of the insulation of the conductor at any point would not, normally, result in any leakage current, and consequently could go for a long time undetected. Should, however, the insulation of the lead fail at this or at any other point on that particular length the conditions of a system with earthed but unbonded leads would be partly reproduced with the attendant evils. It therefore becomes essential to have some means of checking the insulation of both the conductor and the lead. Regarding any particular length of cable, it is quite apparent that if the conductor insulation be faulty, and that of the lead be good, the lead will become alive. By testing the lead, first for potential then for insulation, an excellent knowledge is obtained of the state of the particular length. With the lead of the cables isolated at each box, it is impossible to apply such a test. If, however, the lead of the cable be bonded at each box, but with an insulated bond, and, furthermore, if in each disconnecting box the lead of each way be connected to an insulated terminal, it is possible for a box inspector to test with test lamps, or, more accurately, with a voltmeter, the insulation of conductor and lead of each length of cable on the system. Should the lead be found alive a conductor fault would be indicated, and this would be tested for in the usual way, the lead being meanwhile earthed at one disconnecting box. In case of an earth on the lead being indicated, this would point either to a neutral fault or to damage to the channel at some point, which would be found by locating the fault on the lead, one of the outers being used as a return wire, the neutral conductor meanwhile being connected.

The provision of an insulated bond at each box should be a comparatively easy matter. The bond would be wiped on to the lead of the cable at a point that would come inside the box close to the gland, and would be of ordinary insulated cable. The attachment of the bond should be done before the lead of the cable is removed for sweating of fittings. This method of bonding would necessitate the use of a box slightly longer than would otherwise be required, and on completion of the job the bond would be in the box surrounded by compound.

The system can easily be extended by connecting together the leads of the cables in the disconnecting box in the same way as are the conductors, and, in the feeder pillars, by connecting the leads of the various distributor ways to the lead of the feeder. The lead of each way from the feeder pillar should be isolated from all other ways of the same or of other feeders in the various boxes, as this will considerably expedite testing operations. The feeder leads at the works can then be connected to a terminal board, so arranged that daily tests of the potential and insulation of each feeder lead can rapidly and conveniently be made. As in the case of services, it is essential to break the continuity of the feeder lead before it leaves the channel to enter the cable subway, the lead in the cable subway being earthed in the usual manner. The earthing of feeder pillars and disconnecting boxes would have to be efficiently carried out. This could best be done by bonding to the nearest water main.

As an alternative to the above method of connecting up

the lead of the feeder cables in the works, a system could be arranged by which they were connected, each through a switch, to a bus-bar, which bus-bar would be put to earth, through a resistance, in a similar way to the neutral of a three-wire system. With this method, the lead of the cables would be maintained normally at earth potential, and by connecting an ammeter between the bus-bar and earth, faults on the conductor would be at once indicated by the passage of a current through the ammeter. By opening the various switches, this fault would at once be localised to a particular feeder, and by testing the various ways at the feeder pillar, to the particular section. The further localisation to the shortest length would be a simple matter. Faults of the insulation of the lead would be tested for, at the works, by opening the various switches and testing with lamps. In case of a fault being indicated, it would be followed up as before. As each way in the feeder pillar is entirely isolated, the tracing of a faulty length will be a very simple matter, and will take little time, especially if the feeder pillars are provided with an ample number of ways.

A difficulty arises in connection with a system as outlined above when any work, such as connecting a service, which requires the lead of the cable to be exposed, has to be carried out. As there is always a possibility of the lead becoming alive through a conductor fault, special precautions would have to be taken before working. The most thorough method would be to disconnect the length of lead in the nearest disconnecting boxes, and to earth it to the frame of one box. If disconnecting boxes with diving-bell covers were used, this would be quite a simple matter, and would take up little time. The jointer would, of course, test the lead for insulation and potential before and after his work, and report any defect.

Such a cable system as has been described would, if properly maintained, make a bad fault or burn-out a very remote possibility. By maintaining efficient insulation of the lead, a conductor fault, while being immediately detected, is comparatively harmless, and a good insulation of the lead, indicating, as it does, that the channeling of the cables is in perfect order, makes conductor faults the more unlikely. The system would fail in the case of simultaneous faults in the conductor and the lead, and an earth would be put on the conductor network. By manipulation of the switches connecting each feeder lead to the earth bus-bar, the lead of the section containing the conductor fault could be isolated from earth and the neutral of the conductor system restored to earth potential. If the faults on the conductor and lead were both on the same feeder section the earth could not, of course, be removed so easily, but by disconnecting each way at the feeder pillar in turn, the lead of the faulty way could be isolated, unless again the two faults were on the same sub-section, when the conductor fault would have to be followed up and removed. The possibility of the simultaneous occurrence of two faults is not great, especially on the same feeder section, certainly not greater than the simultaneous occurrence of two faults on each outer, or on an outer and neutral of an ordinary three-wire system with bonded and earthed cable leads. The system, of course, affords no protection against mechanical damage. It should be noted that the method of locating conductor faults to the shortest length by testing the lead for potential, not only can be carried out with the utmost ease without interruption of supply, but, by reason of the isolation of each feeder way, with very much greater speed than by direct tests on the distributor conductors, as the sections will all be very small, and a test at the feeder pillar will leave little to be done.

The writer is not aware that a system such as has been described has ever been carried out. The method of insulating and isolating each length of lead is well known, but with such a system it is impossible to form any accurate idea of the state of the insulation of the conductors. The insulation of the network to earth may be high, while the insulation of the conductor to lead may be low in many places, and, moreover, conductor faults can develop and accumulate in number without detection, till, in course of time, the insulation of the lead begins to deteriorate generally, when the penalty has to be paid for the false security that has for a time been enjoyed. With an insulated and bonded system, double insulation is fully maintained and utilised, but easy means are adopted frequently to determine the insulation of both conductor and lead. A fault on either causes no inconvenience or interruption of supply, but can be located and repaired in comfort. The method of isolating feeder sub-sections enables faults to be found very quickly and easily, while finally, the great bugbear of the conscientious mains engineer, neutral faults, which with an ordinary system are so difficult to locate, are indicated with the system described as an earth on the lead, and are located with the same ease and expedition as faults on the outers.

EQUIPMENT OF KING GEORGE DOCK, HULL.

(*Concluded from page 342.*)

The hydraulic pumping station is situated at the east end of the estate, adjacent to the coal hoists.

The installation consists of four sets of three-throw horizontal pumps, each capable of delivering 250 gallons of water per minute, against a pressure of 850 lb. per square inch.

Each pump is driven through a single reduction, machine cut, double helical gear by a 200 B.H.P. open type motor, the pumps, motor and bearings for the gearing, being mounted on a cast-iron bedplate of substantial design. The motors run at 500 R.P.M., and the pump crankshaft at 55 R.P.M.

The rams are of hard manganese bronze 5¼ in. diameter, and have a stroke of 18 in. The cylinders are of cast iron with gunmetal neck rings, and have single delivery and double suction valves, the valve boxes, which are of cast steel with hard bronze valves and seats, are bolted direct to branches provided on the cylinders.

Three accumulators are provided; the return water from the system is led into four cast-iron tanks; any leakage in the return water pipe lines is automatically made up in the tanks from the fresh water mains. In the event of the return water supply being interrupted, the tanks can be filled from the dock by four emergency centrifugal pumps, direct driven by 7½ B.H.P. motors.

The starting or stopping of the motors is carried out automatically by the accumulators, when they are at the top and bottom of their stroke.

A square steel tappet rod arranged vertically is partially rotated by tappets fixed on the accumulator. An eccentric at the lower end of the tappet rod controls a hydraulic slide valve, which is connected to the pressure mains. When the accumulator is nearing the bottom of its stroke and the pumps are to be started, the slide valve, moved by the eccentric, admits pressure to a small hydraulic ram, which moves forward against a ram of smaller diameter, which is always connected to the pressure mains. In moving forward, the ram operates an electric tramway type controller, through a simple system of links, levers and gearing. During this movement, the pumps are simply circulating water through a bye-pass connecting the suction and discharge. When the controller is in the "on" position and all the resistance is out of the motor circuit, the operating ram, still moving forward, strikes the tappet of a small hydraulic slide valve, which closes the bye-pass by admitting pressure to the ram of a hydraulically operated valve. The pump is then working under load.

When the accumulator is nearing the top of its stroke and the pumps are to be stopped, the slide valve moved by the eccentric opens the starting ram to exhaust and the above operations are reversed, the starter being brought to the "off" position by the constant pressure ram. This arrangement, by starting and stopping the motors under no load, prevents any excessive rush of current, and has been found to work exceedingly well in practice.

The main feeder cables are connected directly to the bus-bars of the switchboard, which consists of a separate panel for each set of pumps, equipped with double-pole circuit-breakers and ammeter. A watt-meter is fitted, which, together with a Venturi meter in the delivery pipe line, enables the cost of pumping to be accurately kept. At the trials the overall efficiency of the motors and pumps varied from 81 per cent. to 85 per cent.

The coal shipping appliances at present consist of two conveyors situated at Nos. 2 and 3 berths, and one fixed and one movable coal hoist at No. 6 berth, so arranged that both hoists can, if required, deliver into the same ship. These appliances will be added to in the future by probably three additional conveyors or, alternatively, two conveyors and one hoist.

The hoists are operated by hydraulic power, and each is capable of dealing with wagons having a maximum gross weight of 35 tons. The coal conveyor belts are of mild steel plate, supported on link chains.

All the working operations are controlled from a conveniently placed cabin on the main gantry framing, all the spout adjustments being made by means of electrically-driven winches and wire ropes.

The main conveyor is driven by a 220-B.H.P. motor and two sets of steel wheel and chain gearing, a differential gear being fitted to equalise the load on the conveyor chains. The speed of the belts is 120 ft. per minute. The spouts are driven by helical spur gearing and electric motors mounted at the back end of the spout girders.

The capacity of the conveyors is nominally 800 tons per hour, though on the trials this was considerably exceeded.

The dock entrance gates are of the composite type with straight sills and fixed flotation.

The rope barrels are driven by means of machine-cut gears and reversible, three-throw, single acting, oscillating, hydraulic engines, developing 25 B.H.P.

The pumping installation at the graving docks consists of two main centrifugal pumps, a centrifugal drainage pump, and a charging pump.

The pump house is formed between the walls of the two docks, and is covered in by a central skylight and reinforced concrete slabs covered with asphalte and supported by steel joists.

The main pumps each have a mean capacity of 36,000 gallons of water per minute against a head of 40 ft. The two

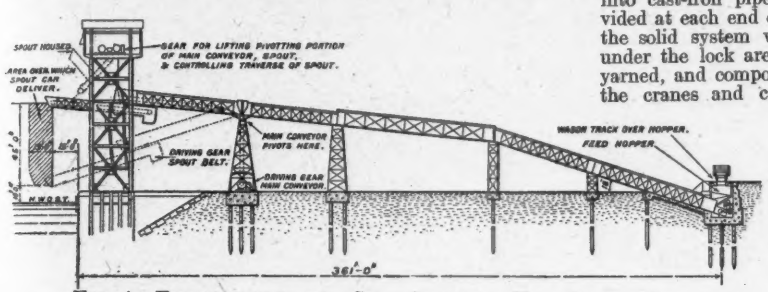

SPOUT HOUSED.
AREA OVER WHICH SPOUT CAN DELIVER.
GEAR FOR LIFTING PIVOTTING PORTION OF MAIN CONVEYOR, SPOUT, & CONTROLLING TRAVERSE OF SPOUT.
DRIVING GEAR SPOUT BELT.
MAIN CONVEYOR PIVOTS HERE.
DRIVING GEAR MAIN CONVEYOR.
WAGON TRACK OVER HOPPER.
FEED HOPPER.
H.W.O.S.T.
361'-0"

FIG. 4.—ELECTRICALLY-DRIVEN COAL CONVEYOR, KING GEORGE DOCK.

pumps working together are capable of emptying the 72-ft. dock in 90 minutes, or the 66-ft. dock in 70 minutes.

The pumps run at 375-416 R.P.M., and absorb a maximum H.P. of 390. They are driven direct by shunt-wound open-type motors of 420 B.H.P., drip shields being fitted over the commutators.

The feeder cables are led to a switch pillar, each pair of cables having two single-pole knife switches, a voltmeter, and watt-hour meter being provided in the pillar.

The bus-bars of the switch pillar are connected to a distribution board, from which the various services to the motors are taken, each service being fitted with pull-out switches.

The starting gear for the main motors consists of an iron-clad pillar, containing an ammeter, shunt field regulator, and a multiple-lever starter. Step-by-step operation is effected by means of a slow motion ratchet type handle; a double-pole circuit breaker is actuated by this handle and is interlocked with the starter, so that the breaker can only be put on when the starter is "off," and the breaker is tripped and cannot be put on again until the starter is returned to the "off" position, in the event of the operator failing to complete the operation of starting.

The drainage pump delivers 3,000 gallons of water per minute when pumping against a total head of 54 ft.

The pump is driven by a 75-B.H.P. semi-enclosed motor at a speed of 1,100 R.P.M. The charging pump is driven through gearing by a semi-enclosed motor of 4 B.H.P.

A 25-ton electric travelling crane running on rails laid on the pier between the two docks, and capable of serving both docks, is now being installed.

The electrical energy for power and lighting is distributed by means of 10 main feeder circuits, arranged as follows:—

Circuit.	*Description of Machines on Circuit.*
A.	Two coal conveyors.
B.	Cranes and capstans north quay, north-west arm.
C.	Cranes and capstans south quay, north-west arm.
D.	Grain silo.
E.	Hydraulic pumping plant.
F.	Graving dock pumping plant.
G.	Cranes and capstans at south quays of main basin and north-east arm.
H, K. & L.	Electric light feeders.

The main switchboard consists of a separate panel for each of the above circuits. Each of the power circuit panels are equipped with an ammeter, two single-pole circuit breakers, and single-pole knife switches to each cable where the feeders consist of more than two cables. The lighting circuit panels are each equipped with two ammeters, two single-pole circuit breakers, and knife switches.

An earthing panel is provided equipped with a circuit-breaker, ammeter, limiting resistance and alarm signals. Watt-hour meters are provided on the lighting and power circuits.

The main bus-bars are fitted with isolating switches, so that the panels controlling circuits B, C, D, and G, or circuits A, E, and F, or circuits H, K, and L can be cut out in case of any fault.

The feeders consist of single conductor cables which, in the case of circuits A, B, C, G, H, K, and L, are led to feeder pillars, from which distributing cables to serve the various machines or lighting circuits are led.

In view of the importance of maintaining an uninterrupted supply to the hydraulic pumps, feeders E and F are connected to the bus-bars of a sub-switchboard, situated near the hydraulic pumping station, from which service cables are taken to the two pumping installations. Each incoming and outgoing cable is fitted with a single-pole switch, so that any pair of the centrifugal pump feeder cables may be used to supply the hydraulic pumps in case of necessity.

The power circuit feeder pillars are equipped with two single-pole switches for each pair of incoming and outgoing pair of cables. The lighting circuit feeder pillars have removable porcelain handle fuses for each sub-feeder.

All the main feeder cables for the power and lighting circuits and distributing cables for power are of the single conductor type, paper insulated and lead sheathed, laid generally on the solid system in earthenware troughing, with tile covers.

In special cases where the ground was soft the cables were laid solid in cast-iron troughs with cast-iron covers. Where the cables were laid under railway tracks they were drawn into cast-iron pipes, brick pits roofed with flags being provided at each end of the pipes, up to which the troughing of the solid system was laid. The cables laid in the subway under the lock are insulated as above and double armoured, yarned, and compounded overall. The distributing cables to the cranes and capstans on the various quays are single armoured, yarned, and compounded overall, and are supported by cast-iron racks, fixed in the tunnels formed in the quay walls.

The services to the capstans and to the plug boxes for the cranes, are taken from the distributor cables through branch boxes, which are of the solid type where the distributors are supported on racks in the wall tunnels, and of the mushroom type, in brick pits, fitted with roadway frame and cover where the distributors are laid in the ground. The services are connected through links in both types of box.

The lighting sub-feeders and distributors are two or three-core, paper insulated, lead sheathed double-steel tape armoured cables, laid direct in the ground, and protected by creosoted planks. The cables are looped into switchboxes attached to the lamp standards.

The whole of the estate is lighted by electric incandescent and seven-ampere flame arc lamps. The arc lamps, of which there are 132, are supported at a height of 30 ft. above the ground by steel standards. Arc lamps are used exclusively for lighting the railway sidings, the service consisting of bare overhead wires run on insulators carried by cross arms on the lamp standards or intermediate timber posts.

NEW ASH AND CLINKER EQUIPMENT FOR CENTRAL STATIONS.

THE advantages of automatic mechanical equipment for removing ash and clinker must be obvious to everyone who has had anything to do with the operation of large or medium sized boilers. Manual labour is too slow and costly to be satisfactory in this connection. The task is more than can reasonably be expected from flesh and blood, in view of the great quantities of material concerned, and the heat and dust accompanying its removal by other than mechanical means. Also, if the grate and ashpit are kept clean by manual labour, a certain loss of efficiency by admission of cold air is almost certain to occur. On economic, technical, and hygienic grounds alike, it is highly desirable to employ some automatic means of removing hot ash and clinker continuously, and without raising dust.

In the Schwabach system, illustrated in the accompanying figures (from *E.T.Z.*), hot ashes and clinkers fall through chutes straight into a water trough, where they are quenched, and whence they are removed continuously. The chutes dip into the water, so that there is no possibility of dust escaping into the surrounding atmosphere. The ash and clinker ducts, A, B, C (fig. 1), for each grate are grouped together, so that a single waterway serves a whole row of boilers for quenching purposes (fig. 2). The waterway is formed in a concrete plinth which carries a light iron framework for the support of the conveyor chain. The rim of the trough is provided with rails for the chain rollers, and a third rail is provided at the bottom of the trough, so that the conveyor is kept from rubbing on the concrete. Ashes and small pieces of clinker collect to a depth equal to the height of the third rail, and thus furnish further protection against abrasion. The conveyor scoops are so constructed and so set on the chain that no pieces larger than, say, 1½ inches are allowed to fall through or between them, hence there is no risk of scraping the bottom by large pieces caught under the conveyor chain. The latter moves quite slowly, so that the ash

and clinker is thoroughly quenched by the time it reaches the inclined portion of the trough up which it is dragged, prior to being discharged into a tip wagon or on to a removal conveyor, as may be more convenient. The boiler crew is relieved entirely of the duty of opening and closing ash ducts and quenching hot, dry ashes; the action is automatic and continuous.

At the two ends of the trough, the conveyor chain is taken over a driving wheel and over a tension device respectively, return tracks being laid along the top of the ironwork already mentioned. The conveyor is driven by an electric motor through double-reduction worm and spur gearing; attendance and maintenance charges on the equipment are exceptionally low owing to the arrangement of the moving parts and the

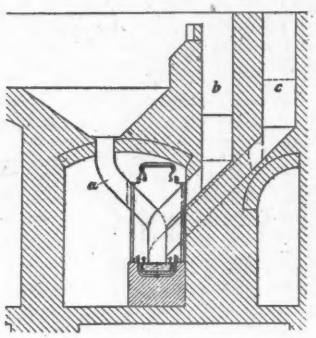


Fig. 1.

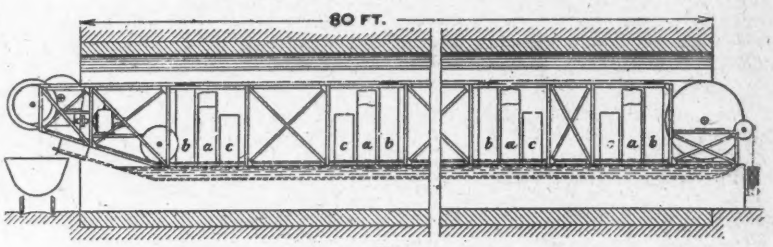


Fig. 2.

New Automatic Ash-handling Equipment.

slow speed at which they are operated. For the same reason, the power requirement is low, say, 1.5 to 2.2 kw.'s for an equipment 80 ft. in length.

Fig. 3 shows, in section, an automatic ash-ejector which may conveniently be employed in conjunction with the above main equipment, to quench and remove dust and ashes from collecting-pockets in flues or other places where this material is collected intentionally or otherwise. An outfall pipe (*a*, fig. 3) of cast or wrought iron is provided at the bottom of the ash receptacle, and the open mouth of this pipe is below the surface of water in a cast-iron box *b*. The water level is kept constant by a ball valve or other means, and thus ensures a dust and gas-tight seal between the dry ashes and the outer atmosphere. Ash and similar material falling into *b* is at once quenched and sinks to the bottom of the box, whence it is removed by wings on a cast-iron wheel *c*, which is set with its spindle perpendicular to the inclined bottom of the box *b* and rotated slowly, through worm gearing *h*, by an

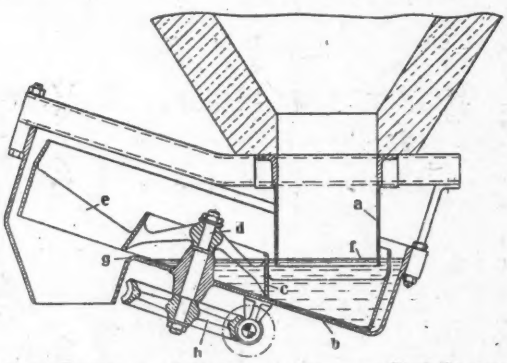


Fig. 3.—Device for Removing Ashes from Flue-Pockets.

electric motor. Quenched ashes carried round by *c* are delivered at *g* into a tip-wagon or other convenient receptacle. A light line shafting may be used, if convenient, to drive a number of such devices. The power required by each amounts only to a few tenths of a kilowatt.

Special advantages of this apparatus are that no cold air can gain admission to the flue *viâ* the ash-box or outfall, and that there is no accumulation of dust or ash necessitating periodical special cleaning. It is only necessary to remove filled trucks from time to time and, even this can be avoided if there is a sufficient quantity of material to justify the provision of a belt or other conveyor for its removal. No dust is raised by the removal of the ashes, nor are there any injurious gases such as rise from hot ash of clinker. The freedom from dust results in a minimum expenditure on the bearings of machinery in the neighbourhood of the boiler house, and the conditions of labour for the boiler crew are improved by better hygienic conditions and the elimination of much manual labour. Any system of ash removal which involves handling dry ashes and quenching them more or less in the open wastes much time and labour and leads to conditions which are unpleasant and injurious both to men and machines. The heat, dust and fumes in such a case are, indeed, so objectionable that the workman spends a good deal of time in evading the effects as far as possible. For this he can hardly be blamed, but it is obviously more economical and in every way more efficient to utilise an entirely automatic and unobjectionable mechanical system.

REVIEWS.

Discovery: Or the Spirit and Service of Science. By R. A. Gregory. London: Macmillan & Co. Price 5s. net.

In this work the author seeks to promote a more sympathetic attitude on the part of the public towards those who are engaged in the pursuit of scientific truth, and to remove the widespread misconception which prevails as to the meaning and influence of science. The book could hardly have appeared at a more opportune time, for the fierce trial through which the country is passing has directed attention to the imperative necessity of encouraging scientific progress as an essential element in the regeneration of the nation and in the maintenance of its economic position amongst the peoples of the world. Prof. Gregory points out that, to the popular mind, a "man of science" is a person who has developed his intellect at the expense of his spiritual nature, and has thus "lost the throbbing and compassionate heart of a full life," and, indeed, this view is not without some excuse, in view of the base purposes to which scientific knowledge has been turned by our enemies; but even as Cæsar's clay might be employed to stop a hole, so the most noble scientific gifts may be prostituted to the service of the devil, and no greater error could be committed than to suppose that science should be blamed for its misapplication. The author, discussing the methods and aims of science from numerous points of view, traverses an immense field, and displays an extraordinarily wide familiarity with the history of scientific progress in all its branches. The book reminds us somewhat of Lubbock's "The Use of Life," in that it draws upon innumerable sources for apt quotations bearing upon the subjects of which it treats. The general method of the author is to select a subject, such as "Belief and Evidence," or the "Conquest of Disease," and to discuss it in the light of scientific methods and aspirations, with numerous illustrations derived from the lives and achievements of researchers of all ages, showing how these men, the salt of the earth, have by slow degrees, and with infinite pains and self-sacrifice, built up the magnificent structure which forms the framework of modern civilisation as we know it. The record is one of surpassing interest, and drives home with irresistible force the claim that scientific discovery has contributed more than any other factor of modern life to human welfare. "Every addition to knowledge is a stepping-stone by which the human race can pass to new regions of discovery. Science asks not for words, but work; for the patient study of the things before us rather than for dreams and vague speculations." Nothing in the book, perhaps, leaves a more enduring impression than the fact, exemplified in scores of cases, that the scientist's is a labour of love; the value of his work is rarely recognised during his lifetime, and hardly ever rewarded in proportion to its merits. But the thirst for knowledge is insatiable, and volunteers are never lacking to devote their lives to the task which, at the time, seems to be useless—to have no "practical application," as the man in the street would say, unconscious of the fact that he enjoys countless privileges and comforts only made possible by those researches which possessed no obvious utility. But the author clearly recognises the necessity of both industrial research and pure scientific investigation, which have their own respective fields to till. We have read the book with the keenest interest and appreciation, and trust that it will gain the widest possible circulation, for the principles which it inculcates are of the highest importance to the future of our race.

The Engineer's Year-Book of Formulæ, Rules, Tables, Data, &c., for 1917. Edited by H. R. Kempe, M.Inst.C.E. London: Crosby Lockwood & Son. Price 20s. net.

We always look forward to the arrival of the new year-book, revised and brought up-to-date, and enriched with new sections; this year nearly 200 pages of new matter have been inserted, but excisions have been made reducing the increase to a net 150 pages. To our mind, this process of

excision is as important as that of extension; many a once well-known hand-book has gradually declined into obscurity and neglect owing to its pages having become overladen with obsolete and useless matter, to the accumulation of independent formulæ giving widely divergent values for the same quantity, and to other defects symptomatic of senility—may this fate never overtake our old friend in the red cover!

Thumb notches giving direct access to the index and to the buyers' guide are external innovations for which we are grateful; ease and rapidity of reference are essential factors of convenience and utility in such a work. New sections deal with water-power development (by A. Surveyer), navigable waterways (by Dr. B. Cunningham), and the metric system (by A. H. Allen), and the section on gasworks has been rewritten (by A. Meade); all these are subjects of vital interest at this time. As for the contents as a whole, to review them *seriatim* would be a colossal undertaking in peace time, and is unthinkable during the war; in any event, it would be a superfluous task, for this is the 24th year of publication of the work, a fact which speaks for itself. We hope the book will not grow much bigger; it already contains 1,946 pages of editorial matter (without the index), and we suggest that the editor should sternly decline to pass the 2,000 mark.

Principles of the Telephone. Part I. Subscribers' Apparatus. By Cyril M. Jansky, B.S., B.A., and Daniel C. Faber, E.E. London: Hill Publishing Co., Ltd. Price 6s. 3d. net.

In their preface to the above volume, which is the first part of a course extending over three volumes, the authors state that in preparing the work every advantage was taken of contact with men engaged in the industry, particularly the engineers of the Wisconsin Telephone Co.; and, although details of construction are not given to any great extent, the principles underlying good construction are aimed at.

In the introductory chapter is described in simple language the method of operating a telephone instrument. The functions of the several pieces of apparatus are explained, and illustrations are given of the assembled parts.

Chapters II and III deal with the elementary facts of electricity and magnetism; and, at the end of each, questions are appended for the purpose of testing the student's knowledge of what he has read.

Chapter IV deals in a simple manner with sound and the transmission of speech telephonically.

Chapter V and VI discuss the various types of modern transmitters and receivers. Self-induction, mutual induction, and impedance are briefly touched upon; and in this connection it is observed that, although the names of the units of resistance, current, pressure, and capacity are duly assigned to these quantities, yet, with becoming trans-Atlantic modesty, the authors suppress the name of their illustrious compatriot in the case of the unit of inductance!

The remaining four chapters are devoted to descriptions of signalling apparatus and circuits, subscribers' set, local battery systems, C.B. telephones, and sub-station apparatus. Lines, methods of leading in, party lines, and intercommunication systems are likewise briefly dealt with. A useful list of faults is also given, and the methods of localising them.

In describing the Leclanché cell, the unusual form "Le Clanche" is employed throughout—a form for which there is no justification, and which is at variance with every French technical work which the writer has consulted.

On page 98, referring to fig. 75, it is stated that the *primary* of the induction coil, transmitter, and receiver are in the line circuit, while the *secondary*, the transmitter, and the condenser form a local circuit. To be in accordance with the diagram, the words primary and secondary should be interchanged.

On pages 18 and 118 references to Ohm's law are made without any formal statement of the law being given to assist the student in its comprehension. The reader must also attend to the definition of a circular mil as given on page 11, otherwise his calculations of the *true* area of circular wires will differ considerably from those in the text and subjoined tables.

Although at times the authors are not so explicit as they might be (*e.g.*, page 121, dealing with the storage of energy in the space surrounding a wire), yet, on the whole, the book is one that may safely be recommended to students taking up the subject of telephony for the first time. The explanations and descriptions given are clearly and simply stated, and the illustrative numerical examples neatly worked out. The many illustrations interspersed throughout, combined with excellent printing, add materially to the merits of this introductory volume.—A. F.

Electrical Engineering: Advanced Course. By Prof. Ernst. Julius Berg, Sc.D. London: Hill Publishing Co. Price 15s. net.

The author, in his preface, explains that this volume contains abstracts of a series of lectures given to graduate students in electrical engineering at the Union College, Schenectady, and that it is primarily intended to prepare the student who uses it to understand and to deal mathematically with phenomena which are incidental to abnormal or transient conditions in electric circuits. While admitting that the subject-matter of the book has been thoroughly treated by other writers, Dr. Berg hopes that justification for his treatise will be found in the fact that his treatment is not beyond the comprehension of a student who has completed only the ordinary undergraduate course in electrical engineering, and he further hopes that it may serve a useful purpose in calling the student's attention to a field of mathematics of extreme importance, but one which is too little known.

The problems dealt with are divided into two parts, of which the first contains the mathematical investigation of transient phenomena in an electrical circuit; while the second part is devoted to problems in electrostatics.

In the part dealing with transient phenomena, the author begins with the simple case of the rise or fall of the current in a simple inductive circuit when an E.M.F. is applied to it, or when a source of E.M.F. is removed. The differential equation for this case is obtained, and its solution discussed and illustrated by several examples in a very clear manner.

Next, the application of an alternating E.M.F. to a circuit containing concentrated inductance and resistances in series is discussed, and again illustrative examples and curves are introduced.

In the following chapter, the influence of a mutual inductance is considered. The treatment is clear and consistent, but it might have been helpful to add some explanation of the connection between circuits which are linked by induction by the diagrammatic method of the "equivalent circuit," which is so useful in many problems. In the "equivalent circuit," windings which are linked by the same flux appear as inductances connected in parallel, while windings which link separate portions of a flux are represented as inductances connected in series.

The next chapter is devoted to a circuit having a variable inductance, *i.e.*, for example, circuits with an iron core. This is followed by a chapter dealing with the effects of a condenser (*i.e.*, a concentrated capacity) in the circuit.

The remaining seven chapters of Part I trace the application of the principles previously given to circuits in which the various constants of the circuit (resistance, inductance, and capacity) are distributed along the conductor, and thus form a mathematical discussion of the conditions existing in long cables and transmission lines. The treatment is entirely mathematical, but follows gradually from the simpler cases already given, so that the student is not confronted suddenly with complex expressions without gradual preparation for realising their meaning and entering upon their solution.

The second part of the book is devoted to problems in electrostatics, and is on lines more in accordance with those found in theoretical treatises on the subject. A graduated mathematical sequence is not possible in this case, and the several parts of the subject are treated in a more isolated fashion.

After a discussion of the fundamental laws, such as Coulomb's Law and Gauss's Theorem, the method of images is applied to point charges. Legendre's Function has a chapter to itself. Then follow chapters dealing with concentric conductors and two-wire and three-wire lines, while the last chapter gives an excellent summary of the principles of electromagnetic radiation in its application to wireless transmission of waves.

The brief analysis which has been given of the contents of the volume will indicate the scope which it covers, and it only remains to say that the author has accomplished his task excellently; his methods are clear and concise, and the result is a very helpful introduction to the study of problems in electrical engineering which demand an advanced mathematical treatment and which, for that reason, are sometimes considered to be beyond the range of students who have not specialised in the higher mathematics. The author has made it possible for any serious student of electrical engineering who is familiar with only that amount of mathematics which is included in an ordinary university course to attack with confidence many complex problems which have an important place in practical engineering design as applied to electrical transmission. For this we owe him our thanks.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

FRANCE.—Some recent decisions of the French Customs Department with regard to the tariff classification of certain articles not specified in the Customs Tariff have been published in the *Journal Officiel*. Among these are:—

Apparatus for transmitting written or spoken messages, which is dutiable under paragraph 524 *bis*—electro-technical apparatus. (The transmitter and registering apparatus are considered as one apparatus and the telephone attachment as another. If the parts are imported separately, each part is regarded as one apparatus.)

Cuprovanadium containing over 5 per cent. of vanadium is dutiable under 205 *bis*—ferro-vanadium.

DENMARK.—Under a Royal Decree, dated January 15th, the warehouse rent for the storing of goods in the State ware-

houses or in Custom houses has been increased by 25 per cent. as from February 1st.

AUSTRALIA.—Under a recent Customs by-law, the following articles, when imported for use in the manufacture within the Commonwealth of dry electric cells, are admitted as "minor articles," and are accordingly free of duty under the Preferential Tariff, and pay 5 per cent. *ad val.* under the General Tariff. The articles in question are brass caps, with nuts; caps for carbons; carbons; zinc cups; and terminals (including binding posts) of brass and nuts and washers therefor, but not including terminals having metal strips or other metal attachments soldered thereto.

ECUADOR.—A new Customs Tariff came into force on January 1st, 1917, under a Law dated October 13th last, which consolidates the duties and surtaxes previously in force. For the purpose of levying import duty, goods are grouped into classes, each class being subject to duty at a prescribed rate. The free list has been added to, and now includes, *inter alia*, electric accumulators and insulators, telegraph and telephone posts and fittings, and industrial machinery. The special local surtaxes on the import duties which are leviable at various ports for specific local purposes remain unchanged, as are also in the main the various charges levied on imported goods, *e.g.*, unloading charges, wharfage charges, &c. Particulars as to the rates of duty leviable on particular goods can be obtained from the Department of Commercial Intelligence, 73, Basinghall Street, E.C. 2.

GAMBIA.—Under the "Customs (Amendment) Ordinance, 1916," invoices for goods to be exported to Gambia may now be authenticated by *any person authorised to administer oaths* in the United Kingdom, as well as by Collectors of Customs. No attestation of invoices is required for imports not exceeding £10 in value.

BRAZIL.—The Brazilian Budget Law for 1917, which came into force on January 1st, authorises the Government to levy import duties on all goods in the proportion of 55 per cent. in gold and 45 per cent. in paper—the proportions fixed by the Bill, as noted in the Review of December 22nd. Among the changes made in the Tariff is the duty on plain, uncovered wire, in cables or cords, for electrical purposes, which is now at the rate of 800 reis per kilog., representing a duty of 30 per cent. Electrodes will continue to pay 8 per cent. *ad val.* The *expediente* (registration) tax on duty-free goods (which is payable on the same basis as the ordinary import duties), and the surtax of 10 per cent. (paper) on that tax, are continued in force. Former provisions are also continued in force whereby the Government is authorised (1) to levy, for the benefit of a port improvement fund, a tax not exceeding 2 per cent. (gold) upon the official values of imports at Rio de Janeiro, Recife, Bahia, Rio Grande do Sul, Maranhao, Ceara, Rio Grande do Norte, Parahyba, Espirito Santo, Parana, Santa Catharina, Matto Grosso, Alagoas, Parnahyba, Aracaju, and Para; and (2) to levy a tax of from 1 to 5 reis per kilog. (according to the value of the goods) on merchandise loaded or discharged at Brazilian ports and destined for or proceeding from other ports.

Consular Invoices. A new form of Consular Invoice is prescribed by the Law. The complete specification of each class of merchandise is to be declared, the commercial description, application, or material being clearly stated. In addition to the country of origin of the goods, the country in which goods were purchased for export to Brazil must be given. Invoices are to be presented for legalisation before the sailing of the vessel carrying the goods; if not, the importer is liable to a penalty equal to double duties for the non-production of the invoices within the period specified for their presentation. The fee for the legalisation of invoices is raised from 3 milreis to 4 milreis (gold).

[Milreis (1,000 reis), gold = 2s. 3d.; milreis paper = 1s. (about).]

FEDERATED MALAY STATES.—Under the "War Taxation Enactment, 1916," a new export duty on cultivated rubber is levied for one year from January 1st, 1917. When the price of cultivated rubber does not exceed 2s. 6d. per lb. the duty is 2½ per cent. *ad val.*; when the price exceeds 2s. 6d. per lb. the duty is 5 per cent. *ad val.*

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

3,937. "Power traverses in electrically-driven lathes, boring mills, &c." E. Stirk, G. Stirk, J. G. Stirk, R. Stirk. March 19th.

3,954. "Ignition devices for internal-combustion engines." R. Taylor. March 19th.

3,956. "Magnetic separators." A. F. Wenger, A. H. C. Wenger and Wengers, Ltd. March 19th.

3,958. "Magneto-electric generators." G. F. Cooke. March 19th.

3,976. "Sparking plug for internal-combustion engines." W. C. Matthews. March 19th.

4,001. "Self-contained electric lighting apparatus." F. D. M. Gordon. March 19th.

4,002. "Medical induction coils." F. D. M. Gordon. March 19th.

4,003. "Electrical heating apparatus." F. D. M. Gordon. March 19th.

4,005. "Galvanometer for use on board ship, &c." J. Rymer-Jones. March 19th.

4,014. "Telephone, &c., diaphragms." B. A. Pilkington. March 20th.

4,036. "Fusible cut-outs." E. S. Conradi & J. F. Conradi. March 20th.

4,047. "Ozone generators." E. L. Joseph & Ozonair, Ltd. March 20th.

4,074. "Supporting indirect or semi-indirect inverted shades for electric lamps." A. Hardie & H. R. Hardie. March 20th.

4,082. "Magnetic compasses." L. E. Cowey. March 20th.

4,089. "Processes of producing metallised brushes for electric machines." Compagnie Generale Electrique. (France, May 22nd, 1916.) March 20th.

4,097. "Permanent electric flashlamp." R. J. W. Ogilvie. March 21st.

4,116. "Means for coupling magneto-generator with internal-combustion engine." D. Y. Wheatley. March 21st.

4,118. "Electric welding machines." G. Gandolfo. March 21st.

4,131. "Apparatus for regulating by hand the time of ignition in internal-combustion engines." Soc. Anon. des Etablissements L. Bleriot.

4,142. "Imitation electric candle lamps." C. Ammentorp & G. Gandolfo. (Denmark, May 20th, 1916.)

4,144. "Magneto-electric machines." O. Pletscher. March 21st.

4,146, 4,147, 4,148. "Oil-insulated electrical apparatus." S. E. Bowrey and Duckham & Co. March 21st.

4,162. "Electrical cables, flexible cords, &c." M. H. Goldstone & J. H. Ward. March 22nd.

4,167. "Sparking plug." J. Dorn. March 22nd.

4,174. "Continuous-current electric generators." R. Boin. March 22nd.

4,177. "Glands for electric cables, &c." G. H. Brough. March 22nd.

4,188. "Electric circuit controllers." Cutler-Hammer Manufacturing Co. and Igranic Electric Co. March 22nd.

4,196. "Electrical transmitting apparatus." H. K. Harris. March 23rd.

4,202. "Globes for enclosing electric glow lamps." T. Tons & Veritys, Ltd. March 23rd.

4,223. "Searchlights." H. Remington. March 23rd.

4,228. "Electric generating and battery-charging installations for railways, &c." A. H. Darker and J. Stone & Co. March 23rd.

4,237. "Electrical condensers and process of making same." Philips-Briston & Co. (U.S.A., March 23rd, 1916.) March 23rd.

4,256. "Means for cooling body of sparking plugs for internal-combustion engines." J. Knight. March 24th.

4,260. "Overhead trolley-guide for electric tramcars." G. R. Goll. March 24th.

4,288. "Apparatus for electric driving of submarines, &c." Volta Soc. Anon. March 24th.

PUBLISHED SPECIFICATIONS.

1915.

13,886. Dynamo-electric Power Transmission Apparatus. F. A. Heys (Neuland Patents, Ltd.). September 30th.

1916.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1,418. Arc Incandescent Lamp for Therapeutic and other purposes. E. A. Gimingham. (July 20th, 1916.) (104,350.)

1,436. Device for Controlling Electric Ignition in Internal-combustion Engines. M. Pensuti. February 3rd, 1915. (100,053.)

2,290. Means of Control for Electro-mechanical Transmissions for Motor Vehicles. W. A. Stevens. February 28th, 1916. (Cognate application, 3,331/16.) (104,370.)

3,036. Polyphase Alternating Electric Current Commutator Machines. British Thomson-Houston Co. & N. Shuttleworth. February 29th, 1916. (104,378.)

3,087. Electric Motor Controllers. J. A. Hurst & P. S. Brook. March 1st, 1916. (104,381.)

3,165. Studs or Electrodes of Electric Discharges. Marconi's Wireless Telegraph Co. & H. M. Dowsett. March 2nd, 1916. (104,385.)

3,166. Aeroplanes fitted with Wireless Telegraph Apparatus. Marconi's Wireless Telegraph Co. & H. M. Dowsett. March 2nd, 1916. (104,386.)

3,230. Electric Motor Driving Mechanism for Machines. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 3rd, 1916. (104,390.)

3,254. Electric Potentiometers. F. Wunsch. March 4th, 1915. (100,139.)

3,255. Voltage Regulating Systems for Electrical Circuits. R. E. Gillmor (Sperry Gyroscope Co., U.S.A.). March 3rd, 1916. (104,391.)

3,726. Manufacture of Electrically-welded Link Chains and Cables. R. Green. March 13th, 1916. (104,397.)

3,739. Coil Supports for Electric Apparatus, such as Transformers. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 13th, 1916. (104,398.)

3,976. Electric Cables. British Insulated & Helsby Cables, Ltd., and E. A. Bayles. March 17th, 1916. (104,401.)

4,247. Electric Transformers. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 22nd, 1916. (104,404.)

4,399. Controlling Mechanism for Electric Motors operating Cranes, Lifts, and the like. British Thomson-Houston Co. & W. L. Wise. March 24th, 1916. (104,407.)

4,620. Spark Plugs. J. W. Baird. March 29th, 1916. (104,410.)

6,379. Magnetos for Ignition Purposes. C. Messerschmidt. June 29th, 1915. (100,782.)

7,178. Electrical Rotary Switches. Armstrong, Whitworth & Co., Sir W. G. Waddingham, W. H. & J. H. Thain. May 19th, 1916. (104,426.)

7,848. Devices for Stripping Insulated Wire. S. G. Wood. June 22nd, 1915. (100,736.)

8,360. Control Systems for Electric Motors. British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.) June 13th, 1916. (104,439.)

8,436. Ammeters and Voltmeters. Walsall Electrical Co. & V. Delebecque. June 15th, 1916. (104,441.)

9,062. Shadeholders for Gas or Electric Light Fittings. R. W. MacLachlan. June 27th, 1916. (104,443.)

10,561. Electric Circuit Controllers. Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.). July 26th, 1916. (104,457.)

11,548. Spark Plugs. J. G. Knutson. August 15th, 1916. (104,463.)

11,924. Lacquering Machines. Sterling Telephone & Electric Co. and A. W. James. August 22nd, 1916. (104,464.)

12,162. Automatic and Semi-automatic Telephone Systems. Relay Automatic Telephone Co. & A. Grahn. August 28th, 1916. (104,467.)

12,737. Electric Sparking Plug. P. H. Sands, A. E. Coney & H. L. Constable. September 8th, 1916. (104,468.)

12,950. Manufacture of Electrically-welded Link Chains and Cables. R. Green. March 13th, 1916. (Divided application on 3,726/16.) (104,469.)

15,443. Battery Cells. W. L. Walker. March 17th, 1915. (Divided application on 3,161/16.) (102,056.)

16,077. Electric Portable High-speed Grinding Attachments for Lathes, Shaping, or like Machines. Canadian-American Machinery Co. (Toronto Type Foundry Co.). November 9th, 1916. (104,480.)